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An analysis of surface waves generated by a submerged hydrofoil

Jones, Cowan E.; Brooks, Wharton H.

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AN ANALYSIS OF SURFACE WAVES
GENERATED BY A SUBMERGED HYDROFOIL

C. E. JONES, JR.
AND
W. H. BROOKS, JR.

1953

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AN ANALYSIS OF SURFACE WAVES
GENERATED BY A SUBMERGED
HYDROFOIL

By

Cowan E. Jones, Jr.
Lieutenant^u, U.S. Navy

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Lieutenant (Junior Grade), U.S. Navy
B.S., U.S. Naval Academy, 1947

Submitted in partial fulfillment of
the requirements for the degree of

NAVAL ENGINEER

From the

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

(1953)

ABSTRACT

TITLE: An Analysis of Surface Waves Generated by a Submerged Hydrofoil.

AUTHORS: Lieutenant Cowan E. Jones, Jr., U. S. Navy
Lieutenant (Junior Grade) Therton H. Brooks, Jr.,
U. S. Navy

Submitted to the Department of Naval Architecture and Marine Engineering on 25 May 1953 in partial fulfillment of the requirements for the degree of Naval Engineer.

This investigation is a study of the characteristics of the surface wave generated by a submerged hydrofoil.

The experimentation is conducted on essentially a two-dimensional basis. Measurements were taken along the centerline of a circulating water channel. The wave generator is an infinite aspect-ratio foil of NACA 4412 designation. Generated under controlled conditions of hydrofoil angle of attack, depth of submergence, and stream velocity, the wave is defined by measurements of basic dimensions such as amplitude and wave length.

Results obtained are:

1. $\lambda \approx \frac{2\pi v^2}{g}$ as predicted by theory.

2. Curves expressing the relationship: amplitude versus angle of attack, submergence and velocity.

It is concluded that deep water waves can be simulated in a circulating water channel. An extension of the range of this type of experimentation can lead to a complete solution to the characteristics of surface waves generated by a submerged hydrofoil.

Cambridge, Massachusetts
25 May, 1953

Secretary of the Faculty,
Massachusetts Institute of Technology,
Cambridge, Massachusetts.

Dear Sir:

In accordance with the requirements for the degree of Naval Engineer, we submit herewith a thesis entitled "An Analysis of Surface Waves Generated by a Submerged Hydrofoil."

Respectfully,

NOTATION

- a. Wave amplitude.
- c. Chord-length of hydrofoil.
- d. Depth of the stream in the flume.
- d_1 . Depth of submersion of the hydrofoil, measured from the surface to the tip of the leading edge.
- F_f . Froude no. of the flume $\sqrt{\frac{V}{gd_0}}$.
- F_h . Froude no. of the hydrofoil $\sqrt{\frac{V}{gC}}$.
- h. Manometer head (feet).
- L. Width of flume.
- Q. Flow rate of the flume (cubic feet/second).
- V. Velocity of flow (feet/second).
- α . Angle of attack of the foil.
- λ . Wave-length.
- l_1 . Horizontal distance from the hydrofoil leading edge to the first wave hollow.
- l_2 . Horizontal distance from the hydrofoil leading edge to the first wave crest.
- y_0 . The vertical distance between the undisturbed stream surface and the first wave hollow.
- y_1 . The vertical distance from the undisturbed stream surface to the peak of the wave formed above the front of the foil (when occurring).

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第二部分

I. INTRODUCTION

The use of hydrofoils attached to the hull of a surface vessel is not a new idea. Their application has been attempted in many ways. In the latter part of the last century, Alexander Graham Bell designed a small high-speed craft equipped with foils which attained remarkable speeds for the power then installed. During World War I, the British Admiralty investigated the possibility of using foils on ships with the idea of lifting a ship bodily out of the water to reduce its susceptibility to torpedo attack, but investigations were abandoned without conclusive results.

The Denny-Brown Stabilizer, which was first introduced commercially in the 1920s, represents a successful application of hydrofoils on surface vessels. The stabilizer consists of a hydrofoil located on each side of a vessel's hull at the turn of the bilge. The hydrofoils are actuated by machinery within the ship which causes them to rotate to counteract and reduce the roll of the vessel in a seaway.

For the past fifteen years hydrofoils for use on high-speed surface craft have become increasingly popular. However, their use has been restricted to very small high-speed craft whose displacement is small enough to permit the foils to lift the craft out of the water. With the exception of the Denny-Brown Stabilizers, no real attempt has been made to apply hydrofoils to large ships.

The attachment of hydrofoils to a ship's hull for the purpose

Journal Article

will. *International Journal of Health Services* 30: 427-447.

Journal article 4 is also full of generalizations to and from
qualitative methods and techniques. While one of the au-
thors' main goals appears to be propagational and to over-
value their own findings, these may result from a lack of clear
methodological control and lack enough alternative methods
of inquiry and interpretation of data, which will, if any honest
writer gives a partial to and not only one-sided view to
ensure scientific equilibrium with other valid research and to con-
tinue to advance knowledge in the field. The limitations and
the moderate basis on which conclusions are derived not
to mention differences in perspectives which are relevant
to the authors' approach and theory cannot be overlooked.
The study's emphasis on barriers and challenges was useful and
also well justified but, unfortunately, no barriers or paths toward safety were
present. A full inquiry will be
more likely to have real educational value. Finally, the
authors' generalizations of qualitative methods from studies
with more diverse populations than that of health care may not be
from any field of study and failing to operationalize of operational
methodologies and triangulation of data, research and the two
methodologies being used will not provide clarity to the
research.

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of reducing wave resistance is a comparatively new idea. In a recent paper, read before the 1953 meeting of the Society of Naval Architects and Marine Engineers, Professor M. A. Abkowitz of M.I.T. presented his ideas and the results of his experiments showing the possibility of reducing the wave resistance of ships by the use of hydrofoils located at the forefoot. Under Professor Abkowitz's supervision, towing tank model experiments have been conducted which have shown qualitatively a decrease of model resistance at high speeds.

The objective of this use of hydrofoils is to achieve a net decrease in resistance by accepting increased frictional resistance in return for a large reduction of wave making resistance.

Wave resistance can be considered essentially a pressure phenomenon in which the pressure gradient around a body moving near or on the free surface of a fluid results in the formation of a system of gravity waves. The most prominent, in the case of a surface hull of large displacement, is the bow wave. A reduction in the amplitude of the generated waves by means of a hydrofoil attached to the hull represents a lower energy loss from the moving vessel, which may result in an increase in speed or a reduction in the required horsepower for a proposed design. The presence of a hydrofoil in the vicinity of a vessel's bow, so located that its generated wave system would partially cancel the ship's generated waves (particularly the bow wave), could reduce the wave making resistance of the vessel. Furthermore, as a secondary advantage, this device, by its very location, has the useful characteristic of reducing the pitching of a vessel in a seaway.

4.01. *Initial and subsequent re-examinations and proceedings to limit the duration and to reduce costs*
4.01.1. *Initial examination* - A mandatory examination will be conducted prior to grant of a trademark application and will be limited to one week of time. The examination process will include an initial review of the application for compliance with the requirements of the Trademark Act and the Canadian Intellectual Property Office's Rules of Practice and Procedure. The examination will also include a search of the Canadian Patent and Trade Mark Database to determine if there is any likelihood of confusion with existing trademarks or other intellectual property rights.
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Once the size of the hydrofoil has been decided upon, the problem of its use with respect to the ship is to be solved optimally so as to obtain the greatest speed of travel. It is therefore necessary that the characteristics of a hydrofoil operating near the surface of a fluid be available. The purpose of this investigation is to analyze the behavior of a typical hydrofoil and determine its characteristics. In a literature survey conducted by the author, it became obvious that no studies pertaining to hydrofoil characteristics in producing surface waves were not available. Certain work has been done in regard to the analysis of surface waves generated by a few geometrical shapes (primarily bodies of revolution) and the general characteristics of surface waves have been theoretically defined. However, no work has been done on hydrofoils. Therefore, it was decided to examine the characteristics of a wave system generated by a particular hydrofoil, operating at various angles of attack, velocities, and depths of submergence.

Attempts to analyze wave generation by hydrofoils previously had been made in the towing tank at N.Y.C., but the results indicated that a towing carriage faster than the installed towing-wire would be necessary for extensive study. The best method available seemed to be a two-dimensional analysis in the circulating water channel installed in the Hydrodynamics Laboratory at N.Y.C.

II PROCEDURE

The wave profile was obtained by running a centerline traverse the length of the test section. The surface elevation at each point was obtained by the point gage; the horizontal distances were fixed by alignment of the telescope cross hairs on the probe tip and reading of location on the scale affixed to the telescope bench. The location of the probe tip may be measured to 0.01 centimeter with such a point gage, and the telescope location read to .02 inches. The instrumentation, simple as it may seem, is very precise in comparison to the inherent fluctuation in a circulating water channel.

The profile points were taken at intervals consistent with the wave length and amplitude, and the curve fixed by these points was the basic result of each run. Because of the large number of runs necessary, averaging of several readings of surface elevation at each point was not feasible. The averaging was done by eye, and only one reading obtained at each point. To avoid errors in instrument reading, profile points were plotted as they were obtained, and examination of the resulting curves showed that this method gave sufficient precision, (see sample profiles appendix C).

In conducting the runs, velocity (V), angle of attack (α), depth of submergence (d_1) and total depth of flow (d_0) were controllable.

To analyze the resulting wave, three types of flow were considered, 1) approach flow, 2) transition zone, 3) steady state wave formed after transition. Wave length of the steady state portion (λ),

and the other two were found to be 100% effective. The results of the study are summarized in Table I. The results show that the 100% effective dose was 10 mg/kg for all three groups. The 50% effective dose was 5 mg/kg for all three groups. The 25% effective dose was 2.5 mg/kg for all three groups. The 12.5% effective dose was 1.25 mg/kg for all three groups. The 6.25% effective dose was 0.625 mg/kg for all three groups. The 3.125% effective dose was 0.3125 mg/kg for all three groups. The 1.5625% effective dose was 0.15625 mg/kg for all three groups. The 0.78125% effective dose was 0.078125 mg/kg for all three groups. The 0.390625% effective dose was 0.0390625 mg/kg for all three groups. The 0.1953125% effective dose was 0.01953125 mg/kg for all three groups. The 0.09765625% effective dose was 0.009765625 mg/kg for all three groups. The 0.048828125% effective dose was 0.0048828125 mg/kg for all three groups. 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wave amplitude in the steady state region (a), and the characteristic dimensions of the transition region (y_0 , y_1 , l_1 , l_2) comprised the data obtained from evaluation of the profiles.

Three types of run were taken, according to the data desired.

1) Full profile the length of the test section or to the point where instability of flow made measurements doubtful. From such a profile, all variables could be measured.

2) A profile from undisturbed approach flow through the transition zone, and surface elevation only of the steady state flow at maximum and minimum points. This yields all data except wave length and shape of the steady state portion.

3) Measurement of elevation of approach flow and of the maxima and minima in the steady state wave. This gives only amplitude of the steady wave.

Evaluation of Data.

Variables were obtained in the following manner.

Type 1 runs) "λ" and "a" represent an average of all steady state waves obtained in each run. This, plus the averaging implicit in drawing a smooth curve through the plotted points, yielded reasonable, consistent results. For the parameters of the transition region, we have, of course, but one measurement per run. Fortunately, the transition zone, free from wall and side support effects, is highly stable, and profile measurements to the order of accuracy of the approach flow were obtainable.

Type 2 runs) "a" is the difference of the averages of maxima and minima. The transition zone is evaluated as in type 1 runs.

representatives and that (B) another store-Quicks will not be sufficiently large
and far off the coast so they could not compete with the existing stores.
Marketing will be undertaken with limitations which will be brief
business hours and no publications which may run to several months
since this is an off-the-shelf operation and will be dependant upon (L)
a close watch. A local office administrator will hold the organization's assets
including all future earnings, 116 million
-dollar and expand with another location and millions & 10
in each store relate not to your company's cost but your total
annual over expenses and the ability with another customer base to
market which relates not to again but
revenue and the base will encourage the marketplace to concentrate. (C)
to another store which is short, never made mistakes with it because there
never quacks with
them.

and the author of the paper, Dr. H. A. Clegg, a well-known palaeontologist, has kindly given me permission to reproduce his figure 5, which shows a diagrammatic reconstruction of the skull of *Archaeopteryx*. The figure is reproduced here in black and white, and it is intended to illustrate the following points:

Type 3 runs) "a" only is evaluated and is, as before, the difference of the averages of maxima and minima.

and the other side of the question. I have been told
that you are anxious to get the best kind
of advice from me, so I suppose it is necessary
to tell you what I think about the whole thing.
I am not a lawyer, but I have had some
experience in the law, and I have been
engaged in many cases of this kind. I
have seen many cases where the
plaintiff has been successful, and
many cases where the defendant
has been successful. In my opinion,
the best way to proceed is to let the
plaintiff have his day in court, and
then let the defendant have his day in
court. If the plaintiff胜了, then he
will be entitled to his money, and
if the defendant胜了, then he
will be entitled to his money. This
is the best way to proceed, and it is
the way that I would recommend to
anyone who is in this position.

III RESULTS

1. There is no measurable damping present over the length of the test section or any discernable damping to the point where wave overfall occurs. As high as ten wave-lengths were observed with no apparent change of amplitude or wave-length.
2. It is possible to simulate deep water effects in a circulatory water channel. See Figure XIII.
3. There is no rise of the surface above the foil section at submergences greater than .95 C.
4. There is no effect on approach flow more than one chord-length ahead of the foil.

5. The theoretical relation

$$\lambda = \frac{2\pi V^2}{g} \quad (1)$$

is confirmed. A plot of this is shown in Figure II .

6. Curves of α/c versus R_e at various angles of attack.
7. Curves of α/c versus d_1/c at various Froude numbers and angles of attack.
8. The following numerical averages and range of variations from these averages were found relating the transition zone to the steady wave:

	y_o/a	L_1/λ	L_2/λ
Avg.	.533	.50	1.04
Min.	.44	.46	0.95
Max.	.67	.54	1.14

(1)

$\sigma_{\text{var}} = \lambda$

II would not agree to add to such a provision a clause to require another to do what it is not required to do; provided always that such a provision should further be subject to the condition that such a clause shall not interfere with any other clause in such a way as to render the whole invalid.

λ_{opt}	λ_{opt}	λ_{opt}
0.000	1.0	0.000
0.000	0.000	0.000
0.000	0.000	0.000

FIGURE I

VARIATION OF WAVE-LENGTH WITH
TOTAL DEPTH OF WATER

$\alpha = 2^\circ$ $d_s = 1.06C$

M.I.T. 25 MAY 1953

C.E. JONES, JR.

W.H. BROOKS, JR.

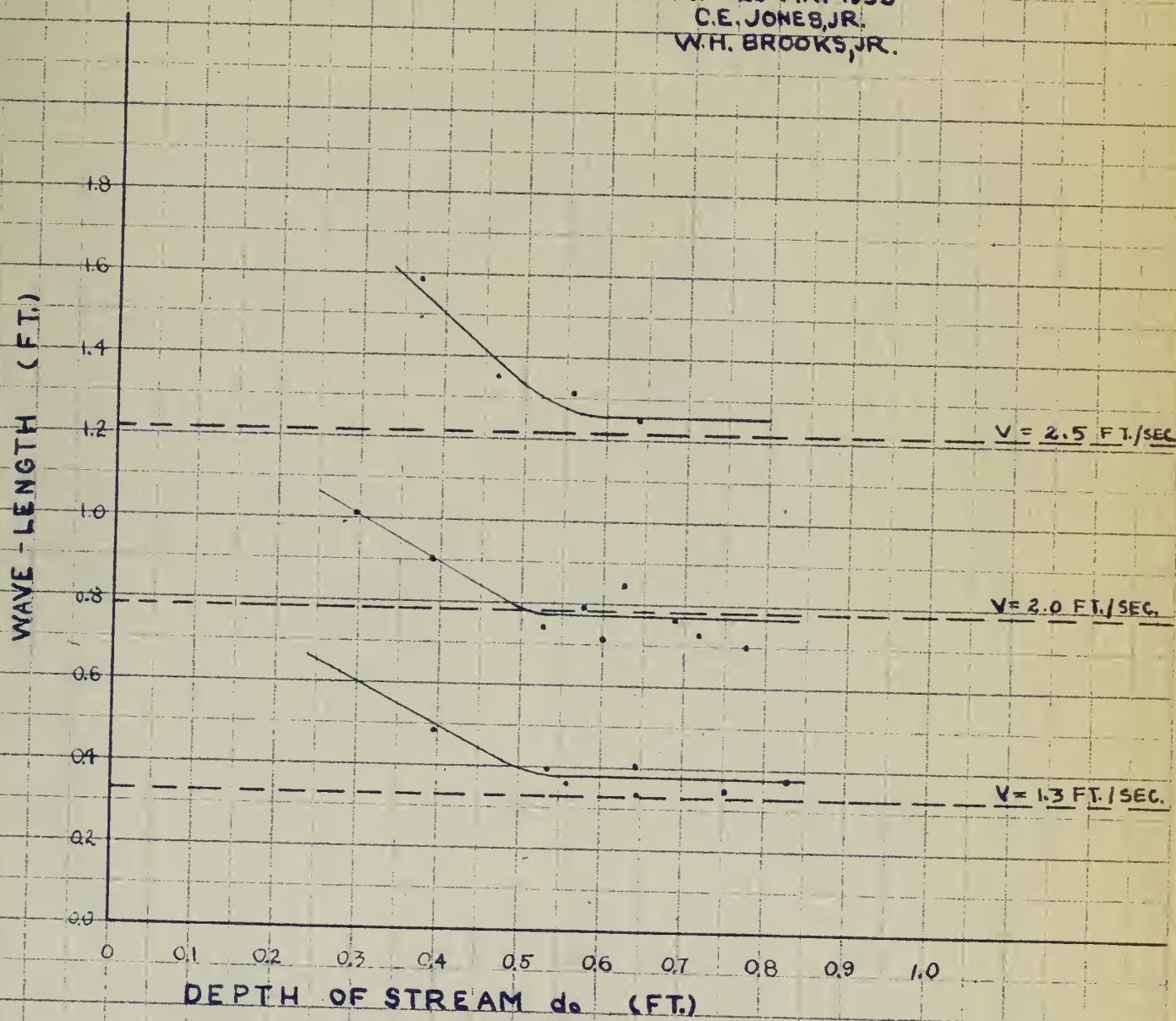
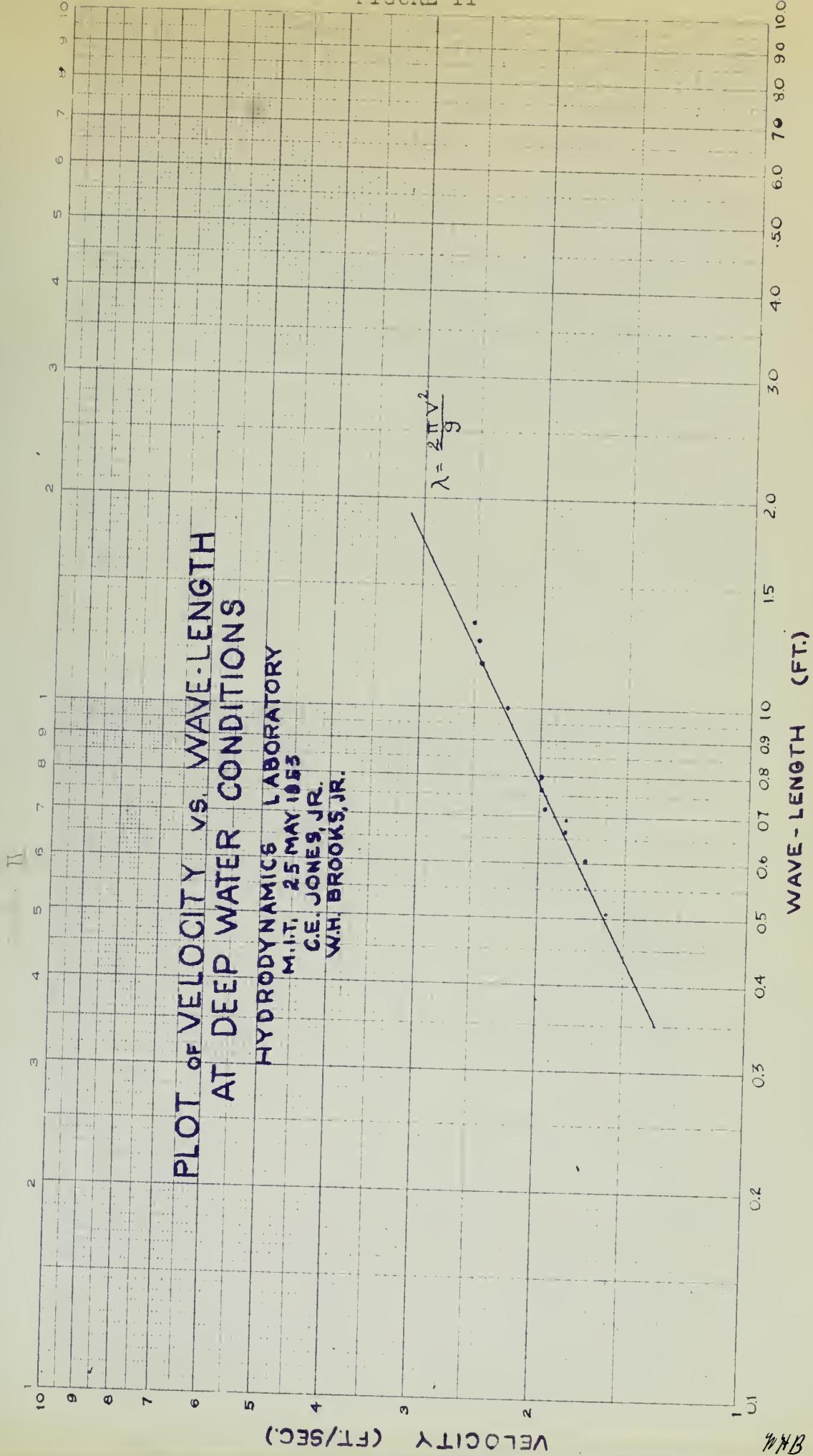
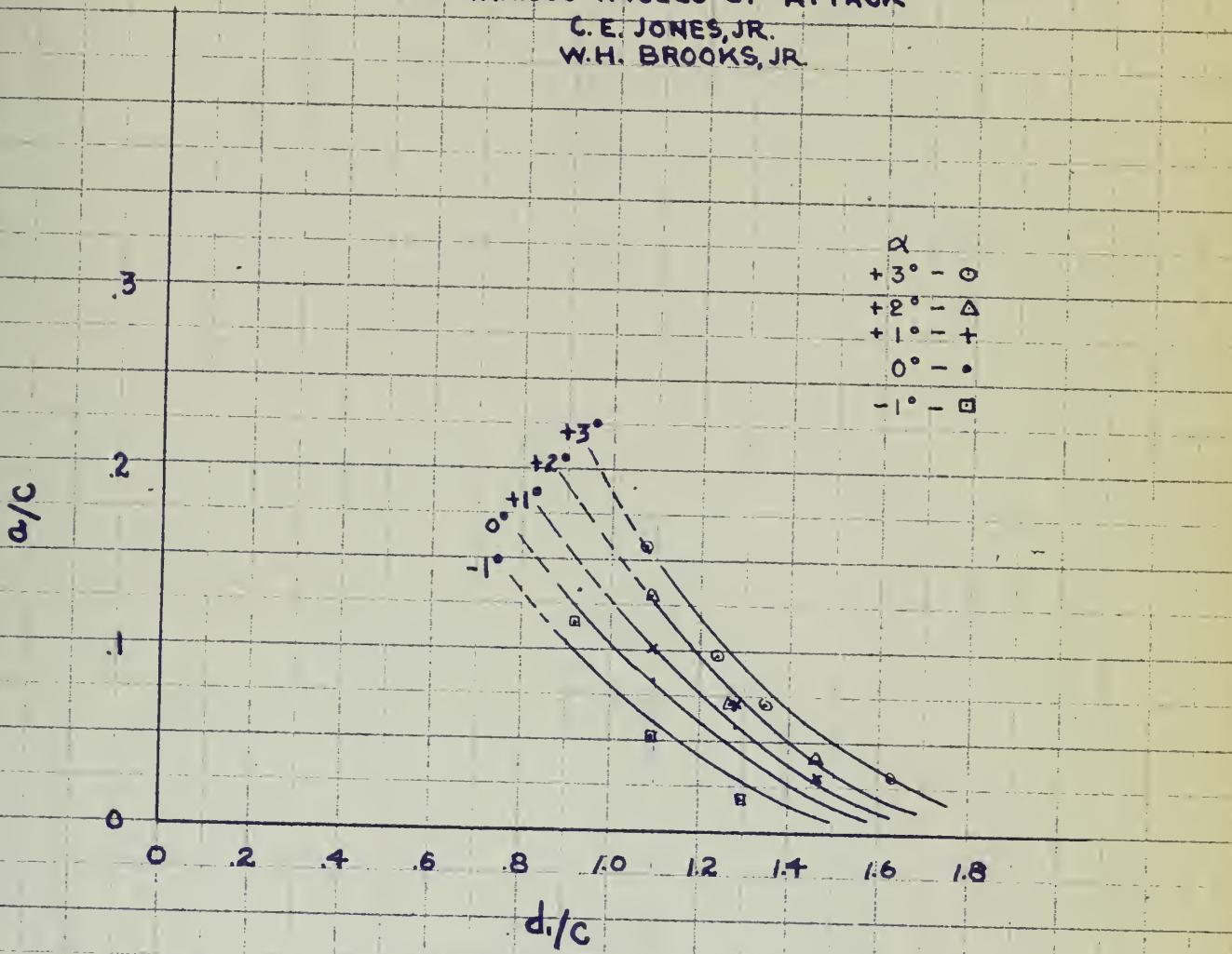


FIGURE II



PLOT OF a/c VS. d/c
 AT $R_e = .550$
 AT VARIOUS ANGLES OF ATTACK
 C. E. JONES, JR.
 W. H. BROOKS, JR.



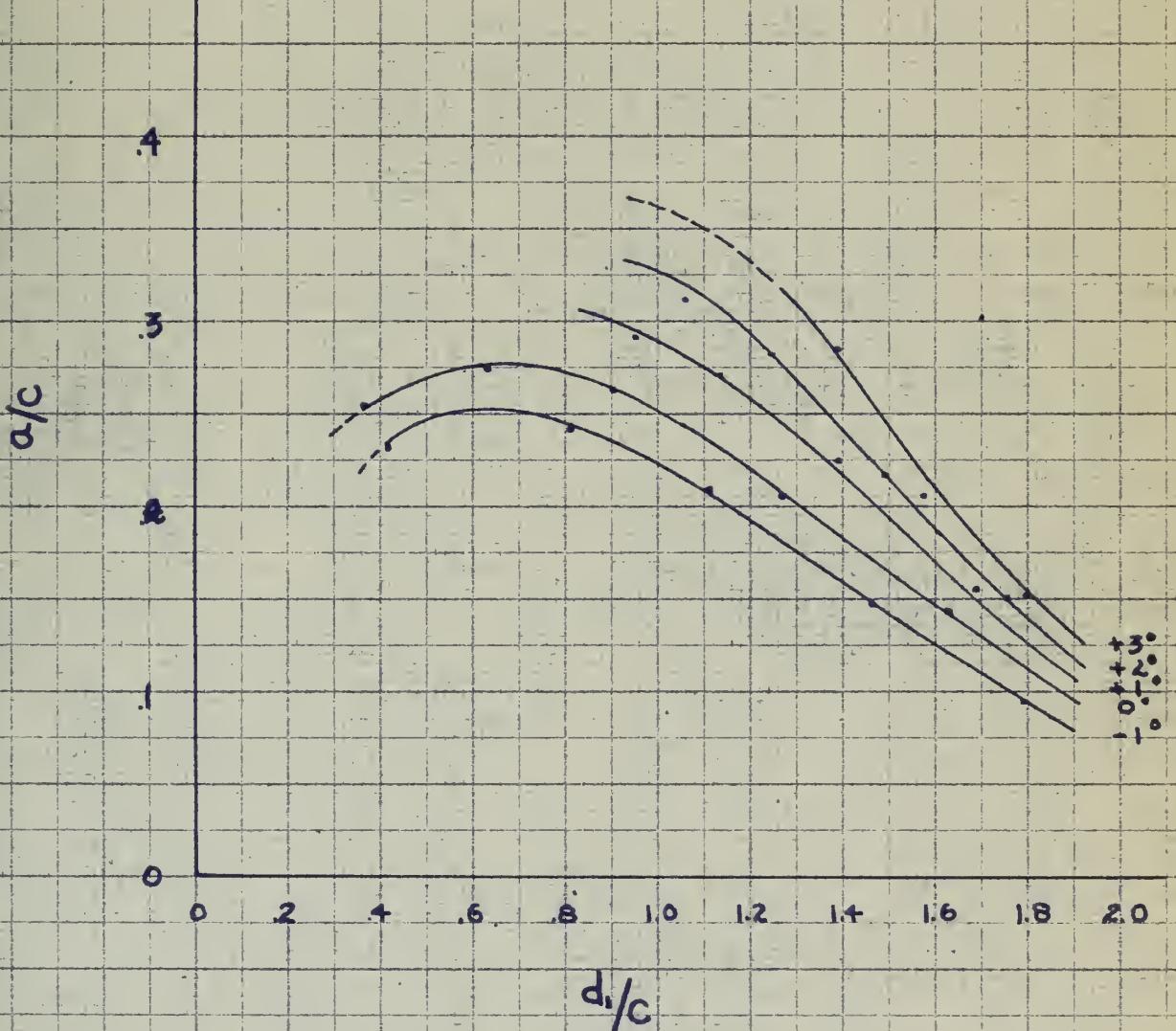
25 MAY 1953

CEG

WFB

FIGURE IV

PLOT OF α/c VS. d_i/c
AT $F_F = .733$
AT VARIOUS ANGLES OF ATTACK
C. E. JONES, JR.
W. H. BROOKS, JR.

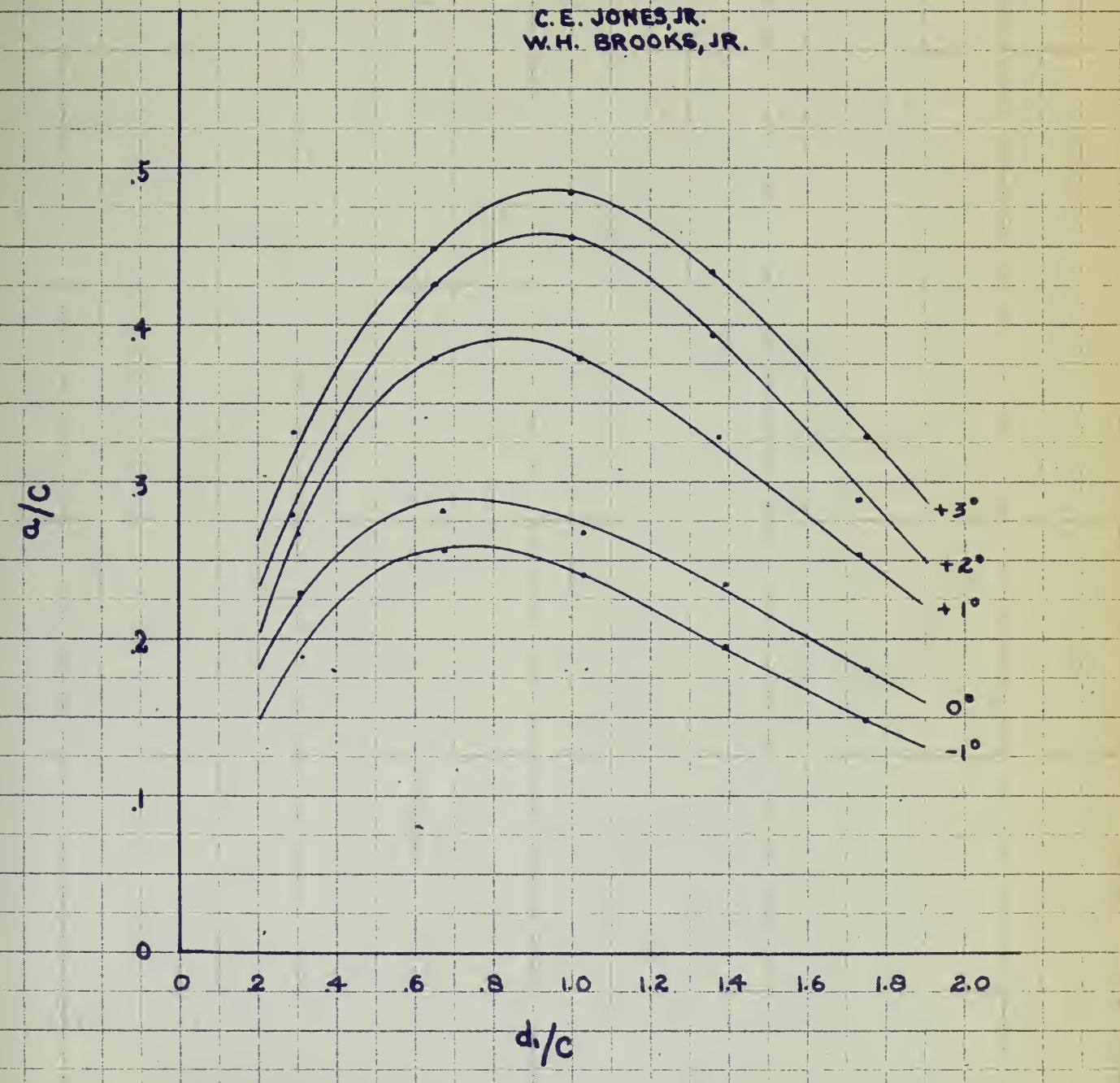


R.S. MAY 1953

ceg

W.H.B

PLOT OF α/C VS. d_i/C
AT $R_i = .920$
AT VARIOUS ANGLES OF ATTACK
C. E. JONES, JR.
W. H. BROOKS, JR.

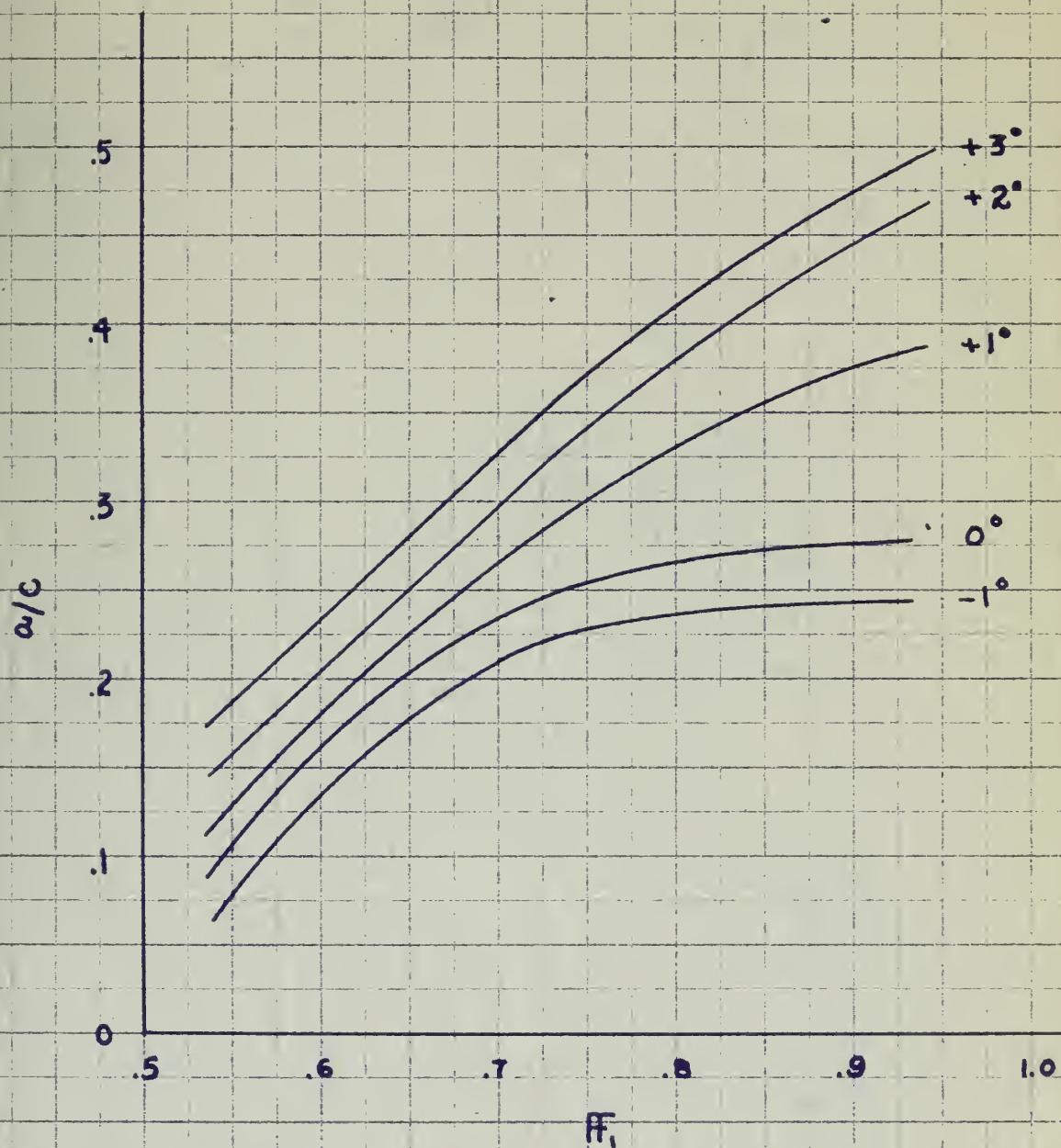


25 MAY 1953

(EJ)

W.H.B.

PLOT OF α/c VS. F_f ,
AT A DEPTH OF SUBMERGENCE
OF 1.0 C
AT VARIOUS ANGLES OF ATTACK
C.E. JONES, JR.
W.H. BROOKS, JR.

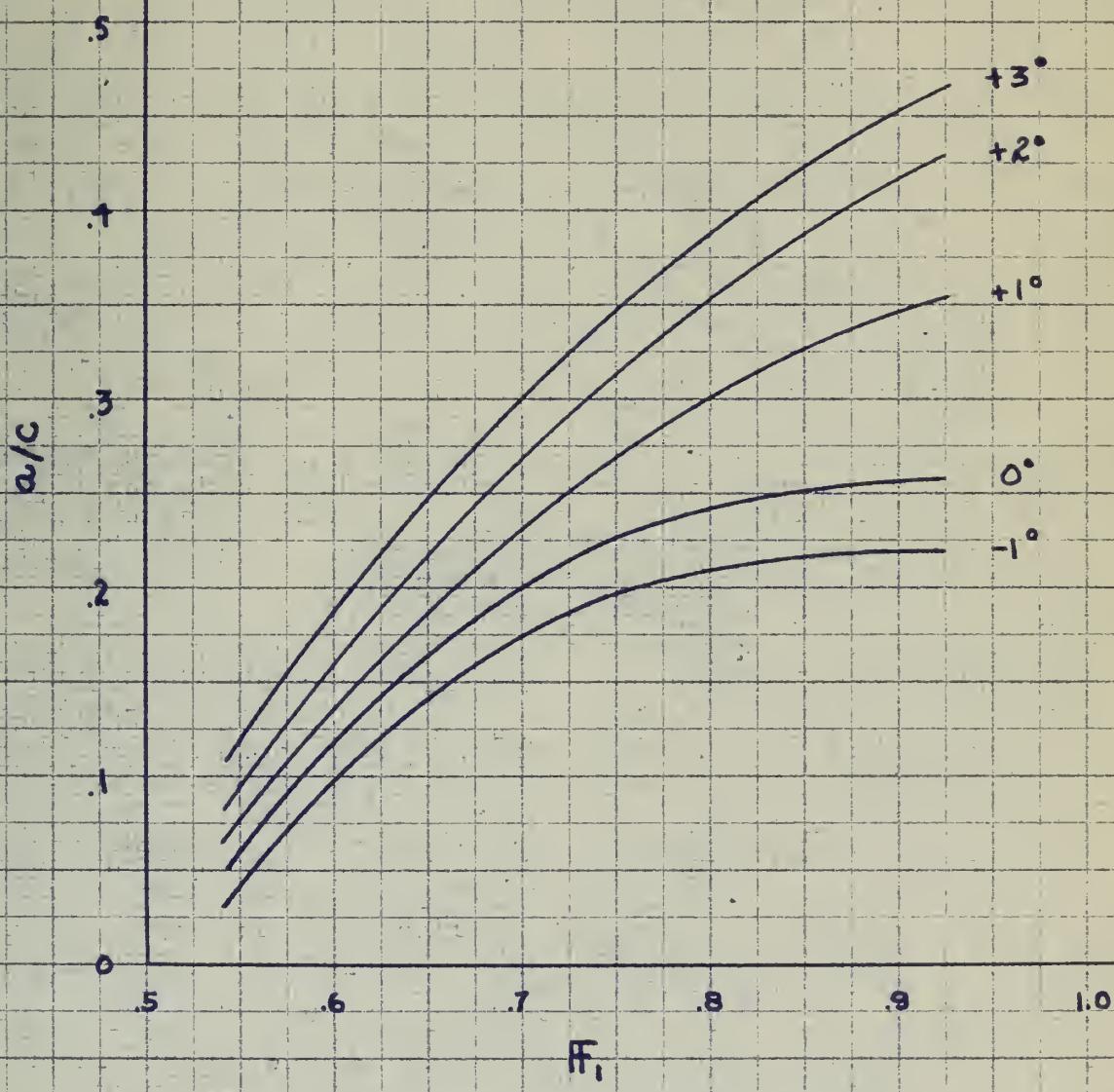


25 MAY 1963

CEJ WAB

FIGURE VII

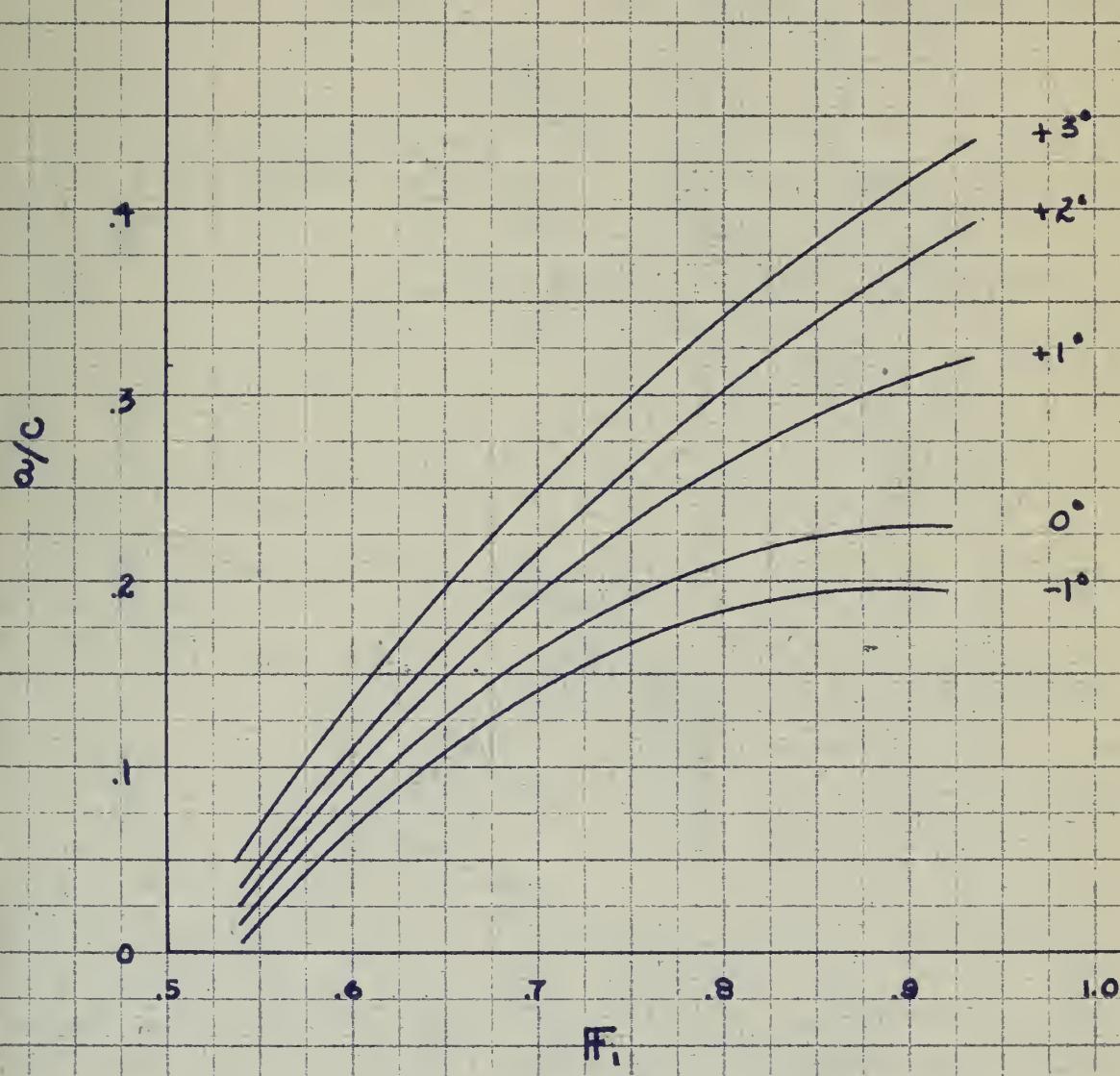
PLOT OF α/c VS. F_i
AT A DEPTH OF SUBMERGENCE
OF 1.2 C
AT VARIOUS ANGLES OF ATTACK
C. E. JONES, JR.
W. H. BROOKS, JR.



25 MAY 1953

CEJ MNB

PLOT OF α/c VS. F_1 ,
AT A DEPTH OF SUBMERGENCE
OF 1.4 C
AT VARIOUS ANGLES OF ATTACK
C. E. JONES, JR.
W. H. BROOKS, JR.

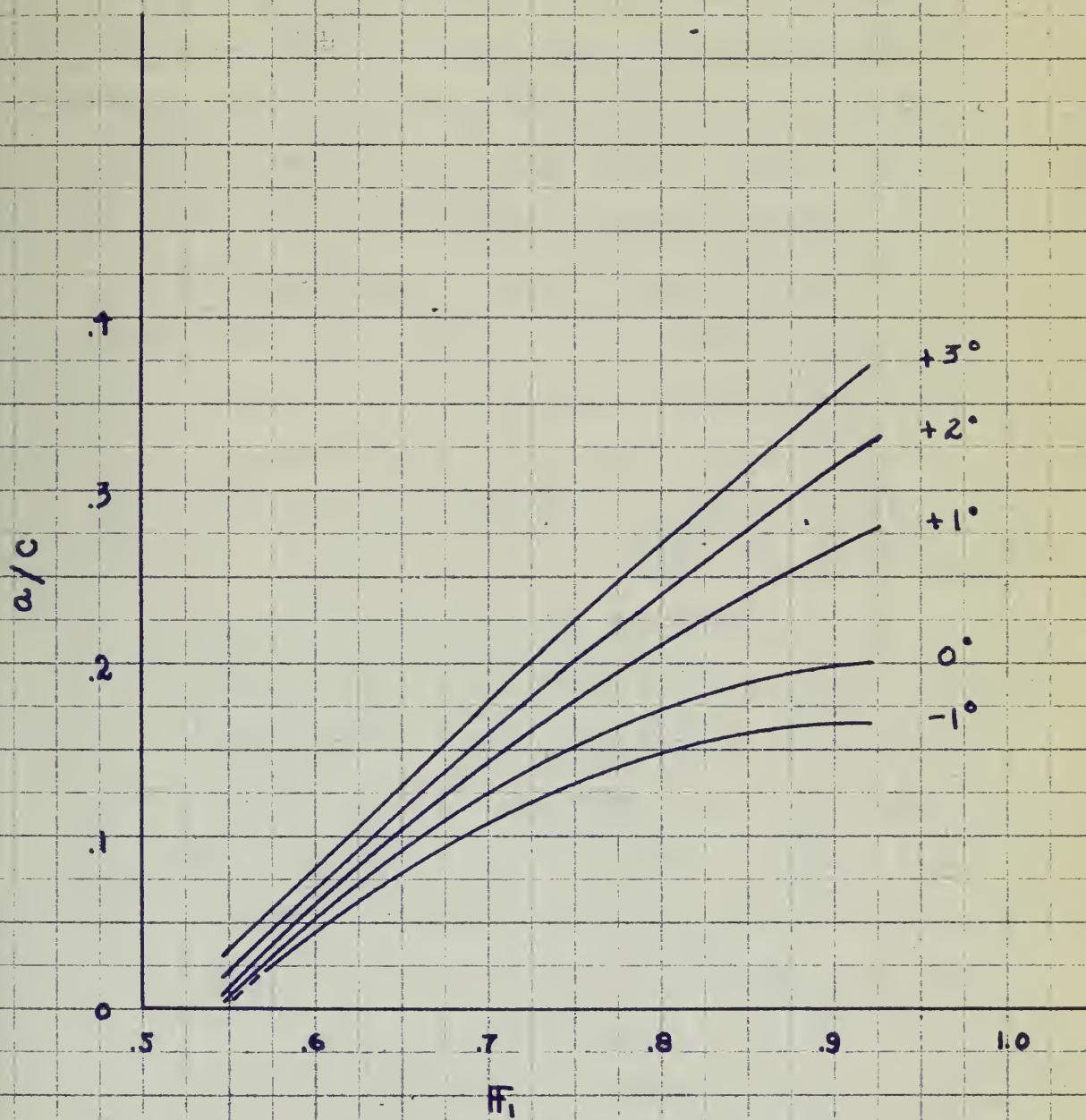


25 MAY 1963

CEY WNB

FIGURE IX

PLOT OF α/c VS. F_F ,
AT A DEPTH OF SUBMERGENCE
OF 1.6 C
AT VARIOUS ANGLES OF ATTACK
C. E. JONES, JR.
W. H. BROOKS, JR.



25 MAY 1953

C2f WNB

IV DISCUSSION OF RESULTS

The object of this research was to find the change in the resulting wave pattern with changes in the conditions of the wave generating hydrofoil. In many cases, the relations were clearly defined and these have been expressed in the preceding section. In other instances (the parameters of the transition zone in particular), where such variations were not clearly defined, interpretation was needed. In these cases, we have made our interpretation and drawn our conclusions. For those who do not agree, the table, Summary of Data, found in appendix B, must comprise the results. It is hoped that sufficient information is expressed therein to aid the research of those individuals interested in hydrofoils.

Since this work was attempted with a view toward the use of hydrofoils in suppression of the wave train of a surface ship, it will be evaluated and interpreted primarily on this basis.

Not previously mentioned in this paper are the serious limitations imposed by the equipment which was used. Principal among them was an overall limitation on range of both velocity and total depth. At the present time, hydrofoils used as wave suppressors have been of chord-length equal to or greater than the draft of the ship model tested. This would mean, in full scale terms, that a destroyer type vessel, operating at a speed of about thirty knots, and using a foil with chord-length of about fifteen feet would give a Froude number on the foil (V/\sqrt{gc}) of about 2.3.

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For a typical merchant vessel with a speed of about twenty knots, using a chord-length of twenty feet, the hydrofoil's Froude number might be 1.3. In our test range, the maximum Froude number attained for the foil was 0.92.

This means that the range of experimentation may not allow direct scaling of the results of these tests to a full size ship. This limit was recognized early in the preliminary analysis, and the use of three sizes of foils of about one, two, and three inches was planned. Manufacturing difficulties prevented the use of more than one foil. It is to be noted that the original proposal would have extended the range of Froude number to a value of 1.7. The extension of the range of Froude numbers tested is recommended in order that the scaling methods of ship model testing may be directly applied.

The use of a range of sizes of foils would also have permitted examination of one more variable, chord-length, and would have allowed a check on the validity of the use of Froude number for a body which does not penetrate the surface. Only limited work has been done on this aspect, but it appears that this is the valid scale factor within the limiting assumptions accepted in ship model testing.

Unfortunately, this work makes no contribution to the problem of determining the shape of surface waves. Attempted analysis of wave shape by numerical methods⁽³⁾ proved unsuccessful. Thus, within the frame of characteristic dimensions presented here, the investigator or ship designer must choose which of the many pro-

which gives birth to new life. In this way we can keep a balance between man and the environment so that we can live in harmony with nature. We must also work to develop a green-minded society where people will respect and care for all living things. This will help us to live in peace and harmony with each other and with the environment.

It is important for us to remember that we are part of a larger ecosystem and that everything we do has an impact on it. We must therefore try to live in a way that respects the environment and the other species that share our planet. This means being kind to animals and plants, not polluting the air and water, and reducing waste. It also means supporting local businesses and farmers who use sustainable practices. By doing this, we can help to ensure a better future for ourselves and for the generations to come.

In conclusion, we must work together to protect the environment and to live in harmony with it. This requires a change in our attitudes and behaviors, but it is essential if we want to ensure a sustainable future for all.

posed theories he desires to use to express the shape of the wave.

No exact correlation of the characteristic dimensions of the transition was found. Examination of these dimensions indicates that their primary relation is to the respective dimensions of the steady state wave. In other words, ℓ_1 and ℓ_2 are increased by any change which increases λ , and y_0 is increased similarly with increases in "a". In the absence of any better correlation, numerical averages and the range of values obtained are presented. It should be noted that, for waves in which there was breaking of the crest of the first wave, the measured values of neither ℓ_2 or of "a" were usable in this analysis. This is easily explained; the breaker is a region of high energy dissipation which affects the energy content of the wave which follows the breaker. Also of interest may be the fact that the presence of a breaker tends to stabilize the wave which follows, and very good measurements of λ are possible.

During the observation of the hydrodynamic behavior of the hydrofoil two important phenomena are noteworthy of mention. First, it was noted that within the velocity range of the investigation there was no perceptible influence on the upstream flow in front of the leading edge of the hydrofoil at distances greater than one chord-length. Second, it was noted that at shallow depths of submergence (d_1) a wave hump appeared above the leading edge of the hydrofoil. These two

and the original title suggests the case of a single individual whose history

is given.

The second part of the paper concerns the results of the study of the
 environmental and the individual factors which may influence the
 incidence of the disease and of the relationship between them from a socio-
 cultural and clinical point of view. These factors include both the socio-environ-
 mental as well as the biological factors which may influence the
 incidence of the disease. The environmental factors studied were
 the type and the amount of exposure to tobacco use, smoking status,
 alcohol use, coffee use, tea use, and the use of illicit drugs. The biological factors
 studied were age, gender, and ethnicity. The results show that there
 is a significant positive correlation between smoking status and the incidence of
 cancer and between coffee and cigarette smoking. There was no significant
 correlation between tea and cigarette smoking. The results also show that there
 is a significant positive correlation between alcohol use and the incidence of
 cancer.

The third part of the paper concerns the results of the study of the
 environmental and individual factors which may influence the incidence of
 cancer. The environmental factors studied were smoking status, alcohol use,
 coffee use, tea use, and cigarette smoking. The results show that there
 is a significant positive correlation between smoking status and the incidence of
 cancer. The results also show that there is a significant positive correlation
 between alcohol use and the incidence of cancer. The results also show that
 there is a significant positive correlation between coffee use and the incidence of
 cancer. The results also show that there is a significant positive correlation
 between tea use and the incidence of cancer.

phenomena are of importance to the ship designer if hydrofoils are to be used to reduce the wave making of a ship. The usefulness of the first phenomena is obvious in that the designer can rely on a free uninterrupted flow up a distance of one chord-length in front of the hydrofoil. The second phenomena, characterized by the dimension y_1 , is not clearly defined at the present time. Only one conclusion is drawn--namely that in no case does a hump appear until the depth of submergence (d_1) decreases below .95c. This fact is useful to the designer in that within the Froude number range of this investigation it indicates that the designer should not locate a hydrofoil at the bow of a ship closer than one chord-length to the surface. Otherwise the presence of the hump will tend to offset the wave reducing feature of the hydrofoil.

The results of this investigation show that not only can a flume be used to study the behavior of a hydrofoil in deep water but also that the shallow water effect can easily be discerned by noting variation in wave-lengths with stream depth at various stream velocities. The resulting curves showing this phenomena need no further amplification.

Fortunately, theory and previous experimental work are available with respect to wave length of a surface wave. That the accepted criteria of λ for waves travelling over the surface of a deep body of water was met in the experimental results is a verification of the proposition that deep water conditions can be simulated in a relatively shallow, circulating water channel.

elbowed to regular girls and of according to the economy
men will with a few girls with the double of their age or
double with half of society at enormous price and to assist
which will be evident in a few days beforehand, will be no other than
to increase among them selfs, ridiculous and the more as these
changes will be carried away by the persons who go back
and now go at such expense which of millions are the well
paid salaries (for example to begin with there would be
an officer sent to recruit self at least at four and a half ,000,
and such rank sent it recruiting self to recruit men from
several cities & to end self to Liverpool a school for boys would
be necessary and sufficient, and the cost of supplies etc etc and
self to recruit number over self will be of four or five thousand
and so on

Liverpool

and also the self with sufficient will be sufficient and
there will be Liverpool & in particular will consist of men of much
of business and others not worth ten thousand will have only one
order to begin with after a few weeks of sufficient salar
and necessary and extra service salaries will continue enough
and sufficient to cover all expenses and
there are three Liverpoolers necessary for each regiment
and self a few months will be enough time to recruit self and
select the best individuals among self & to send the horses
of sufficient numbers and of the same value to give each a to
one thousand dollars value and self to Liverpool and to recruit them a
Lancaster police individuals will be preferable to the London and

Since the generated waves are prone to be more unstable in horizontal location than in amplitude, an appreciable spread of experimental points about the mean line resulted.

With reference to wave stability, α/λ greater than 0.085 could not be achieved because of the breaking of the first wave crest. Following this stabilizing breaker α/λ values as high as 0.092 were achieved.

The relation of amplitude to submergence and angle of attack of the hydrofoil represents the primary result of this investigation. In the absence of comparative theory, the curves picturing this variation must be taken at the value indicated by the small deviations from the mean curves. These are design curves, and in addition lead to the following conclusion: for any angle of attack, there is an optimum depth which will produce the greatest amplitude of generated wave. This depth, in itself, is a function of the angle of attack, increasing with increased angle of attack in the manner shown by the curves of a/c vs. d_1/c at the various angles of attack.

This same information, plotted as a/c vs. F_i , is presented, since this form may well be more useful in design.

and the first time I have ever seen it.

200.0 and above. At 200.0 there was no evidence of association with
any other site in particular. In general, however, at the higher
sites the number of species present decreased. Above
200.0 up
to 300.0 the sites were characterized by small trees, the undergrowth
consisting mostly of shrubs, grasses, and vines. Between 300.0 and 350.
there was a gradual increase in the size of the trees, the undergrowth
consisting mostly of shrubs and vines. Between 350.0 and 400.0 the
trees became larger and more numerous, and the undergrowth
consisting mostly of shrubs and vines. Between 400.0 and 450.0
the trees became larger and more numerous, and the undergrowth
consisting mostly of shrubs and vines. Between 450.0 and 500.0 the
trees became larger and more numerous, and the undergrowth
consisting mostly of shrubs and vines. Between 500.0 and 550.0 the
trees became larger and more numerous, and the undergrowth
consisting mostly of shrubs and vines. Between 550.0 and 600.0 the
trees became larger and more numerous, and the undergrowth
consisting mostly of shrubs and vines. Between 600.0 and 650.0 the
trees became larger and more numerous, and the undergrowth
consisting mostly of shrubs and vines. Between 650.0 and 700.0 the
trees became larger and more numerous, and the undergrowth
consisting mostly of shrubs and vines. Between 700.0 and 750.0 the
trees became larger and more numerous, and the undergrowth
consisting mostly of shrubs and vines. Between 750.0 and 800.0 the
trees became larger and more numerous, and the undergrowth
consisting mostly of shrubs and vines. Between 800.0 and 850.0 the
trees became larger and more numerous, and the undergrowth
consisting mostly of shrubs and vines. Between 850.0 and 900.0 the
trees became larger and more numerous, and the undergrowth
consisting mostly of shrubs and vines. Between 900.0 and 950.0 the
trees became larger and more numerous, and the undergrowth
consisting mostly of shrubs and vines. Between 950.0 and 1000.0 the
trees became larger and more numerous, and the undergrowth
consisting mostly of shrubs and vines.

V CONCLUSIONS

1. This range of experimentation may not allow the results of these tests to be scaled directly to a full sized ship.
2. No clearly defined relationships for the transition region were found.
3. Bow hydrofoils should not be installed at depths of submergence of less than about one chord-length.

In addition, each member and their administrative agencies will .
have a specific bank book to record evidence and other similar
matters pertaining to their implementation function. This will .
allow more
-easier to follow the function of the bank concerned with .
the implementation of the bank will tend to accept

VI RECOMMENDATIONS

1. Extension of the range of F_1 by similar tests to a value of approximately 2.5.
2. The use of geometrically similar foils of a different size to examine the variable, chord-length, and to check the validity of Froude Number as a scale factor.

Experimental Recommendations:

From observations and difficulties experienced, these recommendations are made for refinement of experimental techniques.

1. Insert false side walls in the flume to extend the velocity range and the depth of the flow. This would permit a better attachment of the hydrofoil to the sides and thus eliminate any "strut effect" which is set up by the side supports of the foil.
2. Install a fully adjustable weir gate to permit more precise control of velocity.
3. A more precise method for establishing angle of attack should be used. The present method, with the equipment used in this investigation, requires that the hydrofoil assembly be removed each time and set for a different angle of attack when so desired.

卷之四

To ensure a good number of individuals go to the market will be problematical.

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and families to find suitable alternatives to new suff. S.

The following are some of the characteristics exhibited by cultures of *Sphaerotilus* among a number of others:

1996-1997 Annual Report

For more information about the study, contact Dr. Michael J. Hwang at (319) 356-4320 or email him at mjhwang@uiowa.edu.

Implementation of Information Technology will enhance the quality of delivery and transfer of health services in efficient manner. It

which caused a strong storm and will not be able to do so again
in future the standard road has been set at Listerbyg and is soon

...that will be arranged after each of the six "local" meetings, there being a break between the first and second meetings.

www.ijer.org.in

A more lasting solution to the problem of the surplus labor force is to develop a system of social security which will give the workers a minimum income even if they are unemployed.

— would which all these changes will have probably tendency not least to
put down Dervish as religious teacher, and add others qualities

4. *Leptin* or *relin* deletion to 4.0% from 11.5 ± 3.0% after 100h

VII APPENDIX

APPENDIX A
DETAIL PROCEDURE AND
DESCRIPTION OF EQUIPMENT

A. J. FREDERICK

2012-2013 ALMANAC

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DETAILED PROCEDURE

Preliminary Analysis :

The closest approach to a theory for this problem is the work of Lamb⁽⁴⁾ on surface waves due to a moving pressure disturbance. Though this theory was advanced considering a pressure disturbance at the surface, it was felt that the general method of attack is applicable to disturbances caused by a submerged body. In brief, the theory predicted (a) change of surface elevation over the finite length of the disturbance with the shape of the elevation closely linked to the nature of the disturbance, (b) a transition region of approximately $\frac{1}{2}$ a wave length whose nature was exponential, (c) a damped oscillatory wave. Further, Lord Kelvin had theorized and experimentally checked the fact that no stable wave pattern would result at velocities of less than about 23 cm/sec.⁽⁵⁾

With this background, the method of procedure as stated on page 4 was adopted.

Also apparent in the preliminary analysis was the question of simulating deep water conditions in a channel of this type.

Only this far could theory help; it was necessary to know the general nature of the waves before proceeding.

Sequence of Investigation :

In order to get consistent results, reasonably steady approach flow to the foil had to be achieved. It was considered that this could be accomplished without modification to the channel, as installed, by placing our foil and observation section a distance of about fourteen feet from the inlet. Upon establishing flow with the sluice gate removed from the inlet, it was found that a standing wave existed the entire length of the channel. This difficulty was resolved by lowering the

EXTRACTION

Principles involved:

To draw out the mineral part from a mixture of minerals by separating the non-mineral part.

(1) ^{Simple} Separation of minerals based on their specific gravity. This may be done by water or air. The density of the mineral is compared with that of water or air. The mineral which has greater density than water or air will sink in water or air respectively. (a) Separation of minerals based on their magnetic properties. The mineral which has magnetic property will be attracted towards a magnet. (b) Separation of minerals based on their electrical properties. The mineral which has electrical property will be attracted towards a magnet. (c) Separation of minerals based on their solubility in water. The mineral which is soluble in water will dissolve in water and the insoluble mineral will remain.

(2) ^{Complex} Separation of minerals based on their physical properties such as size, shape, colour, taste, smell, density, etc.

The following are the various methods used for separation of minerals:

- Gravity separation method based on density difference between the minerals.
- Magnetic separation method based on magnetic property of minerals.
- Electrostatic separation method based on electrical property of minerals.
- Flotation method based on surface tension of water.

Separation of minerals is based on the following principles:
1. Density principle: The density of a mineral is the ratio of its mass to its volume. The density of a mineral is determined by dividing its mass by its volume. The density of a mineral is the ratio of its mass to its volume. The density of a mineral is determined by dividing its mass by its volume.

2. Specific gravity principle: The specific gravity of a mineral is the ratio of its density to the density of water at 4°C. The specific gravity of a mineral is determined by dividing its density by the density of water at 4°C.

3. Magnetic susceptibility principle: The magnetic susceptibility of a mineral is the ratio of its magnetic moment to the magnetic field applied to it. The magnetic susceptibility of a mineral is determined by dividing its magnetic moment by the magnetic field applied to it.

4. Electrical conductivity principle: The electrical conductivity of a mineral is the ratio of its electrical resistance to the electrical current passing through it. The electrical conductivity of a mineral is determined by dividing its electrical resistance by the electrical current passing through it.

5. Solubility principle: The solubility of a mineral is the ratio of its mass to the volume of water required to dissolve it completely. The solubility of a mineral is determined by dividing its mass by the volume of water required to dissolve it completely.

6. Size principle: The size of a mineral is the ratio of its diameter to its thickness. The size of a mineral is determined by dividing its diameter by its thickness.

7. Shape principle: The shape of a mineral is the ratio of its length to its width. The shape of a mineral is determined by dividing its length by its width.

8. Colour principle: The colour of a mineral is the ratio of its intensity to its wavelength. The colour of a mineral is determined by dividing its intensity by its wavelength.

9. Taste principle: The taste of a mineral is the ratio of its intensity to its temperature. The taste of a mineral is determined by dividing its intensity by its temperature.

10. Smell principle: The smell of a mineral is the ratio of its intensity to its pressure. The smell of a mineral is determined by dividing its intensity by its pressure.

11. Density principle: The density of a mineral is the ratio of its mass to its volume. The density of a mineral is determined by dividing its mass by its volume.

12. Specific gravity principle: The specific gravity of a mineral is the ratio of its density to the density of water at 4°C. The specific gravity of a mineral is determined by dividing its density by the density of water at 4°C.

13. Magnetic susceptibility principle: The magnetic susceptibility of a mineral is the ratio of its magnetic moment to the magnetic field applied to it. The magnetic susceptibility of a mineral is determined by dividing its magnetic moment by the magnetic field applied to it.

14. Electrical conductivity principle: The electrical conductivity of a mineral is the ratio of its electrical resistance to the electrical current passing through it. The electrical conductivity of a mineral is determined by dividing its electrical resistance by the electrical current passing through it.

15. Solubility principle: The solubility of a mineral is the ratio of its mass to the volume of water required to dissolve it completely. The solubility of a mineral is determined by dividing its mass by the volume of water required to dissolve it completely.

16. Size principle: The size of a mineral is the ratio of its diameter to its thickness. The size of a mineral is determined by dividing its diameter by its thickness.

17. Shape principle: The shape of a mineral is the ratio of its length to its width. The shape of a mineral is determined by dividing its length by its width.

18. Colour principle: The colour of a mineral is the ratio of its intensity to its wavelength. The colour of a mineral is determined by dividing its intensity by its wavelength.

19. Taste principle: The taste of a mineral is the ratio of its intensity to its temperature. The taste of a mineral is determined by dividing its intensity by its temperature.

20. Smell principle: The smell of a mineral is the ratio of its intensity to its pressure. The smell of a mineral is determined by dividing its intensity by its pressure.

sluice gate to create a small head (one to two inches above the level of surface flow) in the inlet tank. This slight contraction of the inlet removed the standing wave, and the length of approach flow was sufficient to take care of the additional surface disturbance caused by the sluice gate.

With satisfactory approach flow established, the foil was placed in the flow; and velocity, submergence and angle of attack were varied to note qualitative effects. Two results were immediately noted: 1) The damping of the wave train was not discernable to the eye; 2) Lord Kelvin's prediction as to minimum velocity was optimistic in terms of stability of this equipment. Only random disturbance was present below a velocity of 1.25 feet per second, and, up to velocities of about 1.4 feet per second, measurement would be difficult.

It was also observed that the foil supports were creating some surface disturbance, and that this disturbance converged at the center of the channel at approximately the second wave crest, independent of the velocity of flow. To the eye, these effects appeared sizable, so it was decided to round the corners of the side supports, and if this did not suffice, to measure the surface profile generated by the supports alone, and try to subtract these values out of the profiles generated by the hydrofoil.

The rounding of the edges of the support pieces produced no change in the size of these disturbances, but, when the supports alone were placed in the flow, there was little or no effect on the surface, and no measurable wave was caused by these supports. Thus, it was decided that the unwanted surface disturbance was being caused, not by the side supports themselves, but by the complex intersection of foil,

wall, and support. This was confirmed by observation that side effect first appeared at the surface at a different horizontal location as depth of the foil was changed (moving downstream, as submergence was increased).

As this could not be eliminated without major changes in the mounting, and it was felt that foil and channel wall alone would produce considerable effect even if the supports were removed from the flow, this three dimensional effect remained throughout the experimentation. However, as plotting of the profiles progressed, it was shown that this effect, though tending to make measurement difficult in the vicinity of the second crest, could be averaged out by careful use of the depth gage. Even with very closely spaced profile points, no appearance of this disturbance could be noted on the plotted profiles at the point where visual observation showed that side effects were present in the centerline profile.

A much more harmful effect of this side effect was its contribution to wave instability, particularly at low velocities, and, if a mounting could be designed to eliminate or reduce these disturbances, a minimum velocity much closer to that predicted by Lord Kelvin might be achieved.

Since this investigation would have been of little value unless it could be related to hydrofoil performance in deep water, it was felt that the first objective must be to determine the effects of the comparatively shallow channel. This was done as follows:

At each of several selected velocities, the controllable variables (angle of attack, depth of submergence, and velocity) were held constant while total depth was varied from the maximum allowed by pump

→ We will have relationships of knowledge and skill → Procedural knowledge, conceptual knowledge, procedural skills, knowledge and skills developed through experience and application to particular situations

not all countries either demand guarantees or can force their oil
-owners to do so. Some do this, while others do not. The
oil-exporting countries are obliged to do so, while others have
nothing to do with it. In general, however, there is no
doubt that the oil-exporting countries will do so, and that
they will do so because they are compelled to do so by
international law. International law, as we have seen,
prohibits the use of force against another state, and
the use of force against another state is illegal under
international law. Therefore, if a country uses force
against another country, it is committing an illegal
act. This is true even if the other country is
engaged in a war of aggression. In such a case,
the use of force is still illegal, because it is
an illegal act. It is also illegal to use force
against another country in order to
protect one's own interests. This is true even
if the other country is engaged in a war of
aggression. In such a case, the use of force
is still illegal, because it is an illegal act.
It is also illegal to use force
against another country in order to
protect one's own interests. This is true even
if the other country is engaged in a war of
aggression. In such a case, the use of force
is still illegal, because it is an illegal act.

means which will be used and more willingly enter into work
and to greater effect notwithstanding the desire of popular writers to
believe that people who are ignorant and have no taste for art and that
they are easily swayed by the opinions of others. I am not
convinced that this is true. I am not, however, convinced that
the public has no taste for good art, but I am not so
sure that they have the power to appreciate it.

capacity to the minimum where total depth was only slightly greater than the depth of submergence. Resulting changes in the characteristics of the generated wave were then the "shallow water effects".

Once the point at which changes occurred was established, investigation proceeded at depths greater than this critical depth and thus deep water runs were simulated.

In addition, the first part of the investigation yielded enough data free of shallow water effects that it was possible to establish the fact that wave length was a function of velocity only.

The remainder of the investigation comprised the collection of sufficient data to establish the effects of α , d_1 , and V on the transition zone and on amplitude of the steady wave.

DESCRIPTION OF EQUIPMENT

THE HYDROFOIL

The hydrofoil selected for this experiment was the N.A.C.A. 4412 airfoil section. The profile of this section is shown in the appendix Table no. I with a tabulation of its coordinates. The choice of this particular profile was based primarily on the availability of existing data of a similar nature which would be useful in the course of this investigation.⁽¹⁾⁽²⁾ This airfoil is 2.8" in chord length and 18" in wing length. It has a 12 percent thickness ratio with a 4 percent camber. The trailing edge was rounded off slightly to facilitate the machining of the foil. The foil was made of dural and was manufactured by a special milling machine in the Sloan Laboratory of the Institute.

THE WATER CHANNEL

A photograph of the water channel is shown in Figure X . This flume is capable of a maximum flow rate of 1200 G.P.M. It is 18" in width and 24 feet in length. The entrance of the channel contained radiator baffling followed by a converging section to stabilize the channel flow rate and produce as little surface disturbance as possible. For the low velocities needed for this investigation (about 1-2 F.P.S.) this arrangement was not quite satisfactory because standing waves were generated on the upstream side of the test section. A satisfactory flow surface was produced by merely lowering the sluice gate until it made contact with the water surface. Surface disturbance variation, (unsteady) was,

卷之三十一

It would not seem odd if animals return back to Harghada. A
bit like 2000-2001 when we had animals go to Libyans or even east
Somali and the animals are brought in now at least 1000 animals of all
of different species. It is believed that most of them were
either sold by HAGC or captured by pirates with no
one has not taken advantage of the
situation to buy the animals.

at the most, about 1 $\frac{1}{2}$ millimeters.

The flow rate of the channel was established by means of a calibrated orifice section located in the piping on the discharge side of the pump. A differential mercury manometer was attached to this section and the flow rate could be obtained by measuring the difference in mercury levels. Then applying the calibration formula

$$Q = 1.806 \sqrt{H} \quad (2)$$

the flow rate and hence the velocity could be determined.

THE MEASURING EQUIPMENT

A depth probe, calibrated in centimeters, was used to measure the heights of the generated waves, the undisturbed stream surface and to establish the vertical height of the foil tip. The probe was mounted on a carriage which could be moved on rails located on top of the flume.

A telescope apparatus shown in Fig. XI was used in measuring the horizontal distances. Due to the long arm on the depth probe, inaccurate horizontal distance readings would result if horizontal distances were measured using the probe carriage. The telescope was mounted on a moving slider which was free to move in a horizontal direction along an aluminum 2 x 2 x $\frac{1}{2}$ " angle. This aluminum angle was securely bolted at each extremity of the observation area and checked for level and cross-level by means of a machinist's level.

A steel tape was laid along the top surface of the angle for use in measuring horizontal distances. Vertical movement of the telescope was achieved by clamping the telescope on a depth probe which in turn was mounted on the slider.

The extent of biodiversity and genetic variation in
agricultural and non-agricultural ecosystems is being studied to obtain
baseline data to monitor changes. Biodiversity is being used to obtain
information on biodiversity values with the aim of determining the best of
conservation and management measures to conserve it.

10

— 1 —

Trichobius corynorhini (Horn) **Fig. 10**

Scutellum of base of pronotum as individual, showing dorsal & few ventral median hairs which are sparse, scattered and do not exceed width of entire scutellum and which become more numerous and longer towards anterior margin. Anterior margin of pronotum slightly convex, with a shallow depression in middle. Lateral margins of pronotum straight, slightly diverging at sides. Posterior margin of pronotum straight, slightly concave in middle. Anterior margin of mesonotum slightly convex, lateral margins straight, slightly diverging at sides. Posterior margin of mesonotum straight, slightly concave in middle. Anterior margin of metanotum slightly convex, lateral margins straight, slightly diverging at sides. Posterior margin of metanotum straight, slightly concave in middle.

and questions to form new IX. All of these questions should be
answered, unless they are not the first set of the questionnaire.
However, I would like most other questions available. I would like
to know some information about the family background, the
present economic condition and the family's social life. I would like
to have some information as to what sort of work the people do.
I would like to know the age of each member and the number of
sons and daughters in each household and the education that can be
had at the time of the survey.

and the right to receive fair and just treatment from all persons and organizations with whom they interact. Accordingly, law enforcement personnel shall treat all people with dignity and respect and in accordance with principles of fairness and justice.

The procedure in using the telescope apparatus is as follows:
the slider is first moved to a desired position on the angle bar.
Then the probe carriage is moved along the length of the flume
until the probe tip is observed in the cross hair of the telescope.
This establishes the abscissa of the particular point on the wave
profile to be measured.

revolution as an alternative response and given the importance of
the role of the media in spreading ideas and beliefs in society, the
media will be argued to play a major role in initiating change and
transforming society. This study will examine the role played by the mass
media and no single relationship can be analysed due to its complexity and

TABLE I
TABLE OF OFFSETS FOR NACA 4412
AIRFOIL SECTION

STATION	UPPER	LOWER	
0	-	0	
1.25	2.44	-1.43	
2.5	3.39	-1.95	
5.0	4.73	-2.49	Leading edge radius ≈ 1.58
7.5	5.76	-2.74	Slope of radius through end of chord $= 4/20$
10.0	6.59	-2.86	Max. mean camber $\approx .04 \times C$
15.0	7.89	-2.88	Location of max. mean camber $\approx .4 \times C$
20.0	8.80	-2.74	
25.0	9.41	-2.50	
30.0	9.76	-2.26	
40.0	9.80	-1.80	Max. thickness $\approx .12 \times C$
50.0	9.19	-1.40	
60.0	8.14	-1.00	
70.0	6.69	-0.65	
80.0	4.89	-0.39	
90.0	2.71	-0.22	
95.0	1.47	-0.16	
100.0	0.13	-0.13	
100.0	-	0	

In the above table the stations are expressed as percentages of the chord length. The ordinates to the upper and lower surfaces are also expressed as percentages of chord length.

The foil used in this investigation was designed for a chord length of 2.80 inches. The trailing edge had to be rounded off slightly to facilitate machining. The actual measured chord length was 2.77 inches.

卷之三

and to implement an integrated curriculum and school-wide set of
norms and policies that align with its mission and values. In this
effort, schools must be willing to make significant changes in their
curriculum, pedagogy, and assessment practices. This requires a
commitment to continuous improvement and a focus on equity and
inclusion. It also requires a clear understanding of the needs of all
students and a willingness to adapt to their unique circumstances.



CIRCULATING WATER CHANNEL
Hydrodynamics Laboratory M. I. T.
Foil, telescope, and depth gage
mounted at test section.

FIGURE XI



TELESCOPE
Close-up showing
mount and bench.



HYDROCOLL
Close-up of foil
and movable mount.

FIGURE XIII



POIL IN OPERATION
 $\alpha_0 = 0$ $\lambda = 9.4$ in.
 $V = 2.0$ ft/sec $a = 0.56$ in.
 $d_1 = 3.46$ in.
 $d_0 = 8.27$ in.

FIGURE XIV



FOIL IN OPERATION

$$\alpha = 0^\circ \quad \lambda = 14.6 \text{ in.}$$

$$V = 2.5 \text{ ft/sec} \quad a = 0.78 \text{ in.}$$

$$d_1 = 2.08 \text{ in.}$$

$$d_0 = 7.68 \text{ in.}$$

Note surface rise above
hydrofoil.

APPENDIX B
SUMMARY OF DATA AND
CALCULATIONS

W. J. L. 1874

TABLE II
SUMMARY OF EXPERIMENTAL DATA

RUN NO.	d_1 in.	d_0 in.	α \circ	V ft/sec	λ in.	a in.	y_o in.	y_1 in.	l_1 in.	l_2 in.
7	2.94	9.95	2	1.30	4.5	0.17	0.13	-	2.2	5.0
8	2.92	10.24	2	1.83	8.0	0.50	0.37	-	3.9	R
9	2.94	6.72	2	1.40	5.7	0.42	0.23	-	2.6	5.6
10	2.93	9.03	2	1.72	7.3	0.61	0.30	-	3.8	7.6
11	2.97	7.77	2	1.60	6.1	0.44	0.24	-	2.9	6.6
12	2.94	8.70	2	1.19	4.1	0.13	0.16	-	2.2	4.6
13	2.94	7.20	2	1.98	8.4	0.72	0.43	-	4.2	R
14	2.90	4.75	2	1.32	5.5	0.34	0.16	-	2.3	5.7
15	2.99	6.44	2	1.29	4.8	0.29	0.18	-	2.3	5.5
16	2.93	7.70	2	1.31	5.0	0.24	0.16	-	2.7	5.4
17	2.93	6.72	2	2.51	16.0	1.30	0.64	-	6.5	14.2
18	2.91	4.44	2	2.51	19.3	1.46	0.77	-	7.6	17.0
19	2.97	5.57	2	2.48	16.0	1.40	0.66	-	6.0	14.7
20	2.54	6.95	2	2.24	12.0	1.10	0.45	-	5.2	R
21	3.01	6.32	2	2.03	9.2	0.61	0.43	-	4.0	R
22	3.02	8.4	2	1.99	9.2	0.62	0.47	-	3.9	R
23	2.94	9.2	2	1.97	8.6	0.58	0.37	-	4.2	R
24	2.93	4.66	2	2.01	11.0	0.37	0.52	-	5.2	R
25	2.03	3.53	2	2.00	12.2	0.85	0.63	-	5.2	R
26	2.00	7.5	2	1.84	8.3	0.48	0.41	-	4.4	R
27.5	2.00	7.5	2	2.06	10.1	0.85	0.47	-	5.0	R
28	2.00	7.5	2	2.30	12.0	1.02	0.47	-	6.0	R
29a	1.00	8.31	0	2.00	9.2	0.70	0.26	0.28	4.6	9.5
29b	1.76	8.31	0	2.00	9.4	0.76	0.27	0.16	4.6	9.5
29c	2.50	8.31	0	2.00	9.4	0.73	0.30	-	4.6	9.5
30a	3.51	8.31	0	2.00	10.0	0.57	0.21	-	4.6	9.5
30b	4.50	8.31	0	2.00	10.0	0.40	0.17	-	4.6	9.5
31a	4.88	8.31	2	2.00		0.42	0.22	-	4.2	9.7
31b	4.13	8.31	2	2.00		0.60	0.32	-	4.2	9.7
31c	3.44	8.31	2	2.00		0.78	0.38	-	4.2	9.7
36a	3.85	8.31	3	2.00		0.79	0.45	-	4.2	9.6
36b	4.98	8.31	3	2.00		0.42	0.28	-	4.2	9.6
36c	4.36	8.31	3	2.00		0.57	0.34	-	4.2	9.6
37a	2.64	8.31	1	2.00		0.81	0.43	-	4.2	9.7
37b	3.15	8.31	1	2.00		0.75	0.45	-	4.2	9.7
37c	3.86	8.31	1	2.00		0.62	0.36	-	4.2	9.7
37d	4.70	8.31	1	2.00		0.43	0.21	-	4.2	9.7
38a	4.96	8.31	-1	2.00		0.26	0.16	-	4.4	9.7
38b	4.05	8.31	-1	2.00		0.41	0.20	-	4.4	9.7
38c	3.15	8.31	-1	2.00		0.58	0.28	-	4.4	9.7
38d	2.25	8.31	-1	2.00		0.67	0.32	0.06	4.4	9.7
39	1.16	8.31	-1	2.00		0.64	0.26	0.22	4.4	9.7
40a	4.75	7.65	3	2.51		0.91	0.43	-	6.3	15.4
40b	3.77	7.65	3	2.51		1.20	0.55	-	6.3	15.4

卷之三

TABLE II
(cont'd)

RUN NO.	d_1 in.	d_0 in.	α	V ft/sec	λ in.	a in.	y_0 in.	y_1 in.	l_1 in.	l_2 in.
40c	2.76	7.65	3	2.51		1.34	0.63	-	6.3	15.4
40d	1.80	7.65	3	2.51		1.24	0.71	0.03	6.3	15.4
41a	0.82	7.65	3	2.51		0.92	0.49	0.24	6.3	15.4
41b	4.76	7.65	2	2.51		0.80	0.45	-	6.3	15.2
41c	3.77	7.65	2	2.51		1.09	0.52	-	6.3	15.2
41d	2.80	7.65	2	2.51		1.26	0.63	-	6.3	15.2
41e	1.80	7.65	2	2.51		1.18	0.57	0.08	6.3	15.2
41f	0.81	7.65	2	2.51		0.77	0.43	0.19	6.3	15.2
41g	4.80	7.65	1	2.51		0.70	0.39	-	6.1	15.3
41h	3.81	7.65	1	2.51		0.91	0.45	-	6.4	15.3
42a	2.84	7.65	1	2.51		1.05	0.49	0.04	6.4	15.3
42b	1.82	7.65	1	2.51		1.05	0.52	0.12	6.4	15.3
42c	0.84	7.65	1	2.51		0.74	0.38	0.20	6.4	15.3
42d	4.85	7.65	0			0.50	0.33	-	6.3	15.2
42e	3.85	7.65	0	2.51		0.65	0.37	-	6.3	15.2
42f	2.85	7.65	0	2.51		0.74	0.43	0.06	6.3	15.2
42g	1.85	7.65	0	2.51		0.78	0.45	0.10	6.3	15.2
42h	0.86	7.65	0	2.51		0.63	0.28	0.18	6.3	15.2
43a	4.85	7.65	-1	2.51		0.41	0.30	-	6.4	15.6
43b	3.86	7.65	-1	2.51		0.54	0.35	-	6.4	15.6
43c	2.84	7.65	-1	2.51		0.67	0.37	0.04	6.4	15.6
43d	1.85	7.65	-1	2.51		0.71	0.37	0.14	6.4	15.6
43e	0.87	7.65	-1	2.51		0.52	0.26	0.24	6.4	15.6
44a	2.98	9.65	3	1.50						
44b	3.72	9.65	3	1.50						
44c	4.50	9.65	3	1.50						
44d	3.42	9.65	3	1.50						
44e	3.01	9.65	2	1.50						
44f	3.51	9.65	2	1.50						
44g	4.04	9.65	2	1.50						
44h	3.02	9.65	1	1.50						
44i	3.54	9.65	1	1.50						
44j	4.05	9.65	1	1.50						
44k	2.57	9.65	0	1.50						
44l	3.04	9.65	0	1.50						
44m	3.54	9.65	0	1.50						
44n	2.55	9.65	-1	1.50						
44o	3.04	9.65	-1	1.50						
44p	3.58	9.65	-1	1.50						

This data not taken
in following runs

- NOTE: 1) R in l_2 column indicates breaking at first wave crest.
 2) - in y_1 column indicates no surface rise directly above foil.

During these years he published several articles and books, and was elected a member of the Royal Society in 1905.

TABLE II
(cont'd)

Limits of accuracy in terms of probable error.

d_1	0.02	in.
d_0	0.02	in.
α	0.1°	
V	0.01	ft/sec.
λ	0.3	in.
a	0.05	in.
y_0	0.02	in.
y_1	0.02	in.
l_1	0.2	in.
l_2	0.4	in.

卷之三

“would add nothing to our effort to return to peaceful

TABLE III

TABULATION OF DATA FOR THE PLOT OF THE VARIATION
OF WAVE-LENGTH WITH DEPTH OF WATER TO
NOTE SHALLOW-WATER EFFECTS

$V = 1.30 \text{ ft./sec.}$		$\alpha = 2^\circ$	$d_1 = 2.940 \text{ in.}$		
Run	do (ft.)	$V \text{ ft./sec.}$	V^2	$\lambda \text{ ft.}$	$\lambda \text{ (corrected)}$
7	0.829	1.300	1.69	0.375	0.375
9	0.560	1.485	2.21	0.475	0.363
10	0.752	1.720	2.96	0.608	0.347
11	0.647	1.595	2.55	0.508	0.337
14	0.396	1.320	1.75	0.458	0.413
15	0.536	1.294	1.68	0.396	0.398
16	0.641	1.310	1.72	0.416	0.408

$V = 2.00 \text{ ft./sec.}$		$\alpha = 2^\circ$	$d_1 = 2.940 \text{ in.}$		
Run	do	V	V^2	λ	$\lambda \text{ (corrected)}$
13	0.600	1.975	3.90	0.700	0.718
20	0.579	2.240	5.02	1.000	0.798
21	0.526	2.030	4.13	0.766	0.742
22	0.700	1.990	3.96	0.766	0.774
23	0.718	1.972	3.89	0.716	0.736
24	0.388	2.010	4.04	0.917	0.908
25	0.294	2.000	4.00	1.017	1.017
30	0.689	1.980	3.93	0.750	0.764

$V = 2.5 \text{ ft./sec.}$		$\alpha = 2^\circ$	$d_1 = 2.94 \text{ in.}$		
Run	do	V	V^2	λ	$\lambda \text{ (corrected)}$
17	0.559	2.510	6.32	1.333	1.319
18	0.370	2.510	6.32	1.608	1.59
19	0.464	2.480	6.15	1.333	1.356
40	0.636	2.510	6.32	1.250	1.245

Velocities of 1.3, 2.0, and 2.5 ft./sec. were chosen to show on the curve because most of the runs made during the early part of the investigation were at velocities near these. As shown above all of the wave-lengths were corrected by proportioning based on the ratio of the square of the velocities

$$\frac{\lambda_1}{\lambda_2} = \left(\frac{V_1}{V_2} \right)^2 \quad (3)$$

which was previously established.

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NOTES ON THE USE OF THE TO ESTIMATE
OF AREA TO OTHER AREAS ACCORDING TO
SOME APPROXIMATE METHODS

	$\alpha = \frac{y}{x}$	$\alpha = \frac{x}{y}$	$\sqrt{\frac{x}{y}} \cdot 100\% = \gamma$	
TRIANGLE A	.7	1.4	11.7%	11.7%
TRIANGLE B	.72	1.39	10.5%	10.5%
TRIANGLE C	.74	1.33	7.7%	7.7%
TRIANGLE D	.76	1.31	6.7%	6.7%
TRIANGLE E	.78	1.29	5.7%	5.7%
TRIANGLE F	.80	1.25	4.8%	4.8%
TRIANGLE G	.82	1.22	4.0%	4.0%
TRIANGLE H	.84	1.19	3.3%	3.3%
TRIANGLE I	.86	1.16	2.6%	2.6%
TRIANGLE J	.88	1.13	2.0%	2.0%
TRIANGLE K	.90	1.10	1.5%	1.5%
TRIANGLE L	.92	1.07	1.1%	1.1%
TRIANGLE M	.94	1.04	.8%	.8%
TRIANGLE N	.96	1.01	.6%	.6%
TRIANGLE O	.98	.98	.4%	.4%
TRIANGLE P	1.00	.99	.2%	.2%
TRIANGLE Q	1.02	.98	.1%	.1%
TRIANGLE R	1.04	.97	.05%	.05%
TRIANGLE S	1.06	.96	.03%	.03%
TRIANGLE T	1.08	.95	.02%	.02%
TRIANGLE U	1.10	.94	.01%	.01%
TRIANGLE V	1.12	.93	.005%	.005%
TRIANGLE W	1.14	.92	.002%	.002%
TRIANGLE X	1.16	.91	.001%	.001%
TRIANGLE Y	1.18	.90	.0005%	.0005%
TRIANGLE Z	1.20	.89	.0002%	.0002%

	$\alpha = \frac{y}{x}$	$\alpha = \frac{x}{y}$	$\sqrt{\frac{x}{y}} \cdot 100\% = \gamma$	
TRIANGLE A	.7	1.4	11.7%	11.7%
TRIANGLE B	.72	1.39	10.5%	10.5%
TRIANGLE C	.74	1.33	9.5%	9.5%
TRIANGLE D	.76	1.31	8.7%	8.7%
TRIANGLE E	.78	1.29	8.0%	8.0%
TRIANGLE F	.80	1.25	7.3%	7.3%
TRIANGLE G	.82	1.22	6.7%	6.7%
TRIANGLE H	.84	1.19	6.0%	6.0%
TRIANGLE I	.86	1.16	5.4%	5.4%
TRIANGLE J	.88	1.13	4.8%	4.8%
TRIANGLE K	.90	1.10	4.3%	4.3%
TRIANGLE L	.92	1.07	3.8%	3.8%
TRIANGLE M	.94	1.04	3.3%	3.3%
TRIANGLE N	.96	1.01	2.8%	2.8%
TRIANGLE O	.98	.98	2.3%	2.3%
TRIANGLE P	1.00	.99	2.0%	2.0%
TRIANGLE Q	1.02	.98	1.7%	1.7%
TRIANGLE R	1.04	.97	1.4%	1.4%
TRIANGLE S	1.06	.96	1.1%	1.1%
TRIANGLE T	1.08	.95	.9%	.9%
TRIANGLE U	1.10	.94	.7%	.7%
TRIANGLE V	1.12	.93	.5%	.5%
TRIANGLE W	1.14	.92	.4%	.4%
TRIANGLE X	1.16	.91	.3%	.3%
TRIANGLE Y	1.18	.90	.2%	.2%
TRIANGLE Z	1.20	.89	.1%	.1%

	$\alpha = \frac{y}{x}$	$\alpha = \frac{x}{y}$	$\sqrt{\frac{x}{y}} \cdot 100\% = \gamma$	
TRIANGLE A	.7	1.4	11.7%	11.7%
TRIANGLE B	.72	1.39	10.5%	10.5%
TRIANGLE C	.74	1.33	9.5%	9.5%
TRIANGLE D	.76	1.31	8.7%	8.7%
TRIANGLE E	.78	1.29	8.0%	8.0%
TRIANGLE F	.80	1.25	7.3%	7.3%
TRIANGLE G	.82	1.22	6.7%	6.7%
TRIANGLE H	.84	1.19	6.0%	6.0%
TRIANGLE I	.86	1.16	5.4%	5.4%
TRIANGLE J	.88	1.13	4.8%	4.8%
TRIANGLE K	.90	1.10	4.3%	4.3%
TRIANGLE L	.92	1.07	3.8%	3.8%
TRIANGLE M	.94	1.04	3.3%	3.3%
TRIANGLE N	.96	1.01	2.8%	2.8%
TRIANGLE O	.98	.98	2.3%	2.3%
TRIANGLE P	1.00	.99	2.0%	2.0%
TRIANGLE Q	1.02	.98	1.7%	1.7%
TRIANGLE R	1.04	.97	1.4%	1.4%
TRIANGLE S	1.06	.96	1.1%	1.1%
TRIANGLE T	1.08	.95	.9%	.9%
TRIANGLE U	1.10	.94	.7%	.7%
TRIANGLE V	1.12	.93	.5%	.5%
TRIANGLE W	1.14	.92	.4%	.4%
TRIANGLE X	1.16	.91	.3%	.3%
TRIANGLE Y	1.18	.90	.2%	.2%
TRIANGLE Z	1.20	.89	.1%	.1%

$$\left(\frac{y}{x} \right) = \frac{y}{x}$$

TABLE IV

TABULATION OF DATA FOR THE PLOT OF WAVELENGTH VS
WAVELENGTH FOR THE PAPER ON WHICH.

Run	V	" λ	' λ
8	1.83	8.00	.666
10	1.72	7.30	.698
11	1.595	6.10	.508
17	2.51	16.00	1.334
20	2.24	12.00	1.00
22	1.99	9.20	.766
23	1.97	8.60	.716
26	1.835	8.30	.692
26.5	2.45	11.9	1.165
29-30	1.98	9.6	.300
40	2.48	15.00	1.25

The following calculations serve to substantiate the theory. From the curve of velocity versus wave-length the following points were taken:

$$\begin{array}{ll} \lambda = 1.76 \text{ ft.} & V = 3.00 \text{ ft./sec.} \\ \lambda = 0.44 \text{ ft.} & V = 1.50 \text{ ft./sec.} \end{array}$$

The equation is of the form:

$$\lambda = KV^n \quad (4)$$

$$(1.76 = K(3.00)^n)$$

$$(0.44 = K(1.50)^n)$$

$$\ln \lambda = \ln K + n(\ln V)$$

$$\ln 1.76 = \ln K + n \ln 3.00$$

$$\ln 0.44 = \ln K + n \ln 1.50$$

$$0.565 = \ln K + n 1.098$$

$$-0.823 = \ln K + n 0.405$$

$$1.388 = 0.623 n$$

$$\therefore n = 2$$

$$0.565 = \ln K + 2 (1.098)$$

$$\ln K = -1.631$$

$$K = 0.195$$

$$\therefore \lambda = 0.195 V^2 = \frac{2\pi}{6} V^2$$

25.1	00.0	38.5	0
25.1	10.0	37.5	0.5
25.1	20.0	36.5	1.5
25.1	30.0	35.5	2.5
25.1	40.0	34.5	3.5
25.1	50.0	33.5	4.5
25.1	60.0	32.5	5.5
25.1	70.0	31.5	6.5
25.1	80.0	30.5	7.5
25.1	90.0	29.5	8.5
25.1	100.0	28.5	9.5

and the extent and distribution of new sedimentary units and the timing showed no significant major trends in either

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$$\frac{d}{dt} \left(\rho_{\text{tot}}^2 \right) = -2 \rho_{\text{tot}} \dot{\rho}_{\text{tot}}$$

$\text{MgO} + \text{SiO}_2 = \text{MgSiO}_4$

(100) m^2 m^{-2} mol^{-1}

$$\text{If } \frac{m}{n} = \frac{p}{q}, \text{ then } q = k \cdot n$$

TABLE V

 TABULATION OF DATA FOR PLOTS OF a/c VERSUS d_1/c
 AT VARIOUS ANGLES OF ATTACK

$$V = 2.51 \text{ ft./sec.} \quad F_l = \sqrt{\frac{V}{gc}} = .920 \quad c = 2.77 \text{ in.}$$

$$\alpha = -1^\circ \quad \alpha = 0^\circ \quad \alpha = 1^\circ \quad \alpha = 2^\circ \quad \alpha = 3^\circ$$

a/c	d_1/c								
0.188	0.314	0.228	0.310	0.267	0.303	0.278	0.292	0.332	0.296
0.256	0.669	0.282	0.669	0.379	0.657	0.426	0.650	0.448	0.650
0.242	1.025	0.267	1.029	0.379	1.025	0.455	1.010	0.484	0.996
0.195	1.395	0.235	1.390	0.328	1.375	0.394	1.360	0.433	1.360
0.148	1.750	0.180	1.750	0.253	1.735	0.289	1.725	0.328	1.715

$$V = 2.00 \text{ ft./sec.} \quad F_l = 0.733 \quad c = 2.77 \text{ in.}$$

$\alpha = -1^\circ$	$\alpha = 0^\circ$	$\alpha = 1^\circ$	$\alpha = 2^\circ$	$\alpha = 3^\circ$					
a/c	d_1/c	a/c	d_1/c	a/c	d_1/c	a/c	d_1/c	a/c	d_1/c
0.231	0.419	0.253	0.361	0.292	0.954	0.311	1.060	0.285	1.390
0.242	0.813	0.274	0.635	0.271	1.138	0.282	1.242	0.206	1.575
0.210	1.139	0.264	0.903	0.224	1.393	0.217	1.490	0.152	1.798
0.148	1.462	0.206	1.267	0.155	1.697	0.152	1.760		
0.094	1.790	0.144	1.625						

$$V = 1.50 \text{ ft./sec.} \quad F_l = 0.550 \quad c = 2.77 \text{ in.}$$

$\alpha = -1^\circ$	$\alpha = 0^\circ$	$\alpha = 1^\circ$	$\alpha = 2^\circ$	$\alpha = 3^\circ$					
a/c	d_1/c	a/c	d_1/c	a/c	d_1/c	a/c	d_1/c	a/c	d_1/c
0.115	0.921	0.134	0.928	0.101	1.090	0.130	1.087	0.159	1.076
0.051	1.098	0.083	1.098	0.072	1.280	0.072	1.268	0.098	1.235
0.018	1.292	0.058	1.280	0.029	1.462	0.040	1.460	0.072	1.342
								0.032	1.625

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*...B. WHICH ARE TO STAY AND ARE TO MULTIPPLY
THERE BY SEVEN COUNTRY.*

$$x_1 = 5, x_2 = 10, x_3 = 15, x_4 = 20, x_5 = 25, x_6 = 30$$

$$EFT = \pi \cdot \sqrt{100.00} = 31.4$$

$$q_1 = 30 \quad q_2 = 30 \quad q_3 = 30 \quad q_4 = 30 \quad q_5 = 30$$

$$m_{\tilde{W}} = 0 \quad \Rightarrow \quad m_{\tilde{e}} = 0 \quad \text{and} \quad m_{\tilde{\chi}_1^0} = 0$$

Q = 10 15 20 25 30 35 40

Age	Sex	Mean	SD	Min	Max	Age	Sex	Mean	SD	Min	Max
10-11	Male	10.0	0.5	9.0	11.0	10-11	Female	10.0	0.5	9.0	11.0
12-13	Male	12.0	0.5	11.0	13.0	12-13	Female	12.0	0.5	11.0	13.0
14-15	Male	14.0	0.5	13.0	15.0	14-15	Female	14.0	0.5	13.0	15.0
16-17	Male	16.0	0.5	15.0	17.0	16-17	Female	16.0	0.5	15.0	17.0
18-19	Male	18.0	0.5	17.0	19.0	18-19	Female	18.0	0.5	17.0	19.0
20-21	Male	20.0	0.5	19.0	21.0	20-21	Female	20.0	0.5	19.0	21.0
22-23	Male	22.0	0.5	21.0	23.0	22-23	Female	22.0	0.5	21.0	23.0
24-25	Male	24.0	0.5	23.0	25.0	24-25	Female	24.0	0.5	23.0	25.0
26-27	Male	26.0	0.5	25.0	27.0	26-27	Female	26.0	0.5	25.0	27.0
28-29	Male	28.0	0.5	27.0	29.0	28-29	Female	28.0	0.5	27.0	29.0
30-31	Male	30.0	0.5	29.0	31.0	30-31	Female	30.0	0.5	29.0	31.0
32-33	Male	32.0	0.5	31.0	33.0	32-33	Female	32.0	0.5	31.0	33.0
34-35	Male	34.0	0.5	33.0	35.0	34-35	Female	34.0	0.5	33.0	35.0
36-37	Male	36.0	0.5	35.0	37.0	36-37	Female	36.0	0.5	35.0	37.0
38-39	Male	38.0	0.5	37.0	39.0	38-39	Female	38.0	0.5	37.0	39.0
40-41	Male	40.0	0.5	39.0	41.0	40-41	Female	40.0	0.5	39.0	41.0
42-43	Male	42.0	0.5	41.0	43.0	42-43	Female	42.0	0.5	41.0	43.0
44-45	Male	44.0	0.5	43.0	45.0	44-45	Female	44.0	0.5	43.0	45.0
46-47	Male	46.0	0.5	45.0	47.0	46-47	Female	46.0	0.5	45.0	47.0
48-49	Male	48.0	0.5	47.0	49.0	48-49	Female	48.0	0.5	47.0	49.0
50-51	Male	50.0	0.5	49.0	51.0	50-51	Female	50.0	0.5	49.0	51.0
52-53	Male	52.0	0.5	51.0	53.0	52-53	Female	52.0	0.5	51.0	53.0
54-55	Male	54.0	0.5	53.0	55.0	54-55	Female	54.0	0.5	53.0	55.0
56-57	Male	56.0	0.5	55.0	57.0	56-57	Female	56.0	0.5	55.0	57.0
58-59	Male	58.0	0.5	57.0	59.0	58-59	Female	58.0	0.5	57.0	59.0
60-61	Male	60.0	0.5	59.0	61.0	60-61	Female	60.0	0.5	59.0	61.0
62-63	Male	62.0	0.5	61.0	63.0	62-63	Female	62.0	0.5	61.0	63.0
64-65	Male	64.0	0.5	63.0	65.0	64-65	Female	64.0	0.5	63.0	65.0
66-67	Male	66.0	0.5	65.0	67.0	66-67	Female	66.0	0.5	65.0	67.0
68-69	Male	68.0	0.5	67.0	69.0	68-69	Female	68.0	0.5	67.0	69.0
70-71	Male	70.0	0.5	69.0	71.0	70-71	Female	70.0	0.5	69.0	71.0
72-73	Male	72.0	0.5	71.0	73.0	72-73	Female	72.0	0.5	71.0	73.0
74-75	Male	74.0	0.5	73.0	75.0	74-75	Female	74.0	0.5	73.0	75.0
76-77	Male	76.0	0.5	75.0	77.0	76-77	Female	76.0	0.5	75.0	77.0
78-79	Male	78.0	0.5	77.0	79.0	78-79	Female	78.0	0.5	77.0	79.0
80-81	Male	80.0	0.5	79.0	81.0	80-81	Female	80.0	0.5	79.0	81.0
82-83	Male	82.0	0.5	81.0	83.0	82-83	Female	82.0	0.5	81.0	83.0
84-85	Male	84.0	0.5	83.0	85.0	84-85	Female	84.0	0.5	83.0	85.0
86-87	Male	86.0	0.5	85.0	87.0	86-87	Female	86.0	0.5	85.0	87.0
88-89	Male	88.0	0.5	87.0	89.0	88-89	Female	88.0	0.5	87.0	89.0
90-91	Male	90.0	0.5	89.0	91.0	90-91	Female	90.0	0.5	89.0	91.0
92-93	Male	92.0	0.5	91.0	93.0	92-93	Female	92.0	0.5	91.0	93.0
94-95	Male	94.0	0.5	93.0	95.0	94-95	Female	94.0	0.5	93.0	95.0
96-97	Male	96.0	0.5	95.0	97.0	96-97	Female	96.0	0.5	95.0	97.0
98-99	Male	98.0	0.5	97.0	99.0	98-99	Female	98.0	0.5	97.0	99.0
100-101	Male	100.0	0.5	99.0	101.0	100-101	Female	100.0	0.5	99.0	101.0
102-103	Male	102.0	0.5	101.0	103.0	102-103	Female	102.0	0.5	101.0	103.0
104-105	Male	104.0	0.5	103.0	105.0	104-105	Female	104.0	0.5	103.0	105.0
106-107	Male	106.0	0.5	105.0	107.0	106-107	Female	106.0	0.5	105.0	107.0
108-109	Male	108.0	0.5	107.0	109.0	108-109	Female	108.0	0.5	107.0	109.0
110-111	Male	110.0	0.5	109.0	111.0	110-111	Female	110.0	0.5	109.0	111.0
112-113	Male	112.0	0.5	111.0	113.0	112-113	Female	112.0	0.5	111.0	113.0
114-115	Male	114.0	0.5	113.0	115.0	114-115	Female	114.0	0.5	113.0	115.0
116-117	Male	116.0	0.5	115.0	117.0	116-117	Female	116.0	0.5	115.0	117.0
118-119	Male	118.0	0.5	117.0	119.0	118-119	Female	118.0	0.5	117.0	119.0
120-121	Male	120.0	0.5	119.0	121.0	120-121	Female	120.0	0.5	119.0	121.0
122-123	Male	122.0	0.5	121.0	123.0	122-123	Female	122.0	0.5	121.0	123.0
124-125	Male	124.0	0.5	123.0	125.0	124-125	Female	124.0	0.5	123.0	125.0
126-127	Male	126.0	0.5	125.0	127.0	126-127	Female	126.0	0.5	125.0	127.0
128-129	Male	128.0	0.5	127.0	129.0	128-129	Female	128.0	0.5	127.0	129.0
130-131	Male	130.0	0.5	129.0	131.0	130-131	Female	130.0	0.5	129.0	131.0
132-133	Male	132.0	0.5	131.0	133.0	132-133	Female	132.0	0.5	131.0	133.0
134-135	Male	134.0	0.5	133.0	135.0	134-135	Female	134.0	0.5	133.0	135.0
136-137	Male	136.0	0.5	135.0	137.0	136-137	Female	136.0	0.5	135.0	137.0
138-139	Male	138.0	0.5	137.0	139.0	138-139	Female	138.0	0.5	137.0	139.0
140-141	Male	140.0	0.5	139.0	141.0	140-141	Female	140.0	0.5	139.0	141.0
142-143	Male	142.0	0.5	141.0	143.0	142-143	Female	142.0	0.5	141.0	143.0
144-145	Male	144.0	0.5	143.0	145.0	144-145	Female	144.0	0.5	143.0	145.0
146-147	Male	146.0	0.5	145.0	147.0	146-147	Female	146.0	0.5	145.0	147.0
148-149	Male	148.0	0.5	147.0	149.0	148-149	Female	148.0	0.5	147.0	149.0
150-151	Male	150.0	0.5	149.0	151.0	150-151	Female	150.0	0.5	149.0	151.0
152-153	Male	152.0	0.5	151.0	153.0	152-153	Female	152.0	0.5	151.0	153.0
154-155	Male	154.0	0.5	153.0	155.0	154-155	Female	154.0	0.5	153.0	155.0
156-157	Male	156.0	0.5	155.0	157.0	156-157	Female	156.0	0.5	155.0	157.0
158-159	Male	158.0	0.5	157.0	159.0	158-159	Female	158.0	0.5	157.0	159.0
160-161	Male	160.0	0.5	159.0	161.0	160-161	Female	160.0	0.5	159.0	161.0
162-163	Male	162.0	0.5	161.0	163.0	162-163	Female	162.0	0.5	161.0	163.0
164-165	Male	164.0	0.5	163.0	165.0	164-165	Female	164.0	0.5	163.0	165.0
166-167	Male	166.0	0.5	165.0	167.0	166-167	Female	166.0	0.5	165.0	167.0
168-169	Male	168.0	0.5	167.0	169.0	168-169	Female	168.0	0.5	167.0	169.0
170-171	Male	170.0	0.5	169.0	171.0	170-171	Female	170.0	0.5	169.0	171.0
172-173	Male	172.0	0.5	171.0	173.0	172-173	Female	172.0	0.5	171.0	173.0
174-175	Male	174.0	0.5	173.0	175.0	174-175	Female	174.0	0.5	173.0	175.0
176-177	Male	176.0	0.5	175.0	177.0	176-177	Female	176.0	0.5	175.0	177.0
178-179	Male	178.0	0.5	177.0	179.0	178-179	Female	178.0	0.5	177.0	179.0
180-181	Male	180.0	0.5	179.0	181.0	180-181	Female	180.0	0.5	179.0	181.0
182-183	Male	182.0	0.5	181.0	183.0	182-183	Female	182.0	0.5	181.0	183.0
184-185	Male	184.0	0.5	183.0	185.0	184-185	Female	184.0	0.5	183.0	185.0
186-187	Male	186.0	0.5	185.0	187.0	186-187	Female	186.0	0.5	185.0	187.0
188-189	Male	188.0	0.5	187.0	189.0	188-189	Female	188.0	0.5	187.0	189.0
190-191	Male	190.0	0.5	189.0	191.0	190-191	Female	190.0	0.5	189.0	191.0
192-193	Male	192.0	0.5	191.0	193.0	192-193	Female	192.0	0.5	191.0	193.0
194-195	Male	194.0	0.5	193.0	195.0	194-195	Female	194.0	0.5	193.0	195.0
196-197	Male	196.0	0.5	195.0	197.0	196-197	Female	196.0	0.5	195.0	197.0
198-199	Male	198.0	0.5	197.0	199.0	198-199	Female	198.0	0.5	197.0	199.0
200-201	Male	200.0	0.5	199.0	201.0	200-201	Female	200.0	0.5	199.0	201.0
202-203	Male	202.0	0.5	201.0	203.0	202-203	Female	202.0	0.5	201.0	203.0
204-205	Male	204.0	0.5	203.0	205.0	204-205	Female	204.0	0.5	203.0	205.0
206-207	Male	206.0	0.5	205.0	207.0	206-207	Female	206.0	0.5	205.0	207.0
208-209	Male	208.0	0.5	207.0	209.0	208-209	Female	208.0	0.5	207.0	209.0
210-211	Male	210.0	0.5	209.0	211.0	210-211	Female	210.0	0.5	209.0	211.0
212-213	Male	212.0	0.5	211.0	213.0	212-213	Female	212.0	0.5	211.0	213.0
214-215	Male	214.0	0.5	213.0	215.0	214-215	Female	214.0	0.5	213.0	215.0
216-217	Male	216.0	0.5	215.0	217.0	216-217	Female	216.0	0.5	215.0	217.0
218-219	Male	218.0	0.5	217.0	219.0	218-219	Female	218.0	0.5	217.0	219.0
220-221	Male	220.0	0.5	219.0	221.0	220-221	Female	220.0	0.5	219.0	221.0
222-223	Male	222.0	0.5	221.0	223.0	222-223	Female	222.0	0.5	221.0	223.0
224-225	Male	224.0	0.5	223							

TABLE VI
NUMERICAL AVERAGES RELATING THE
TRANSITION TO THE STEADY WAVE

Run	$y_0/a(\%)$	Run	$L_1/\lambda (\%)$	Run	$\frac{L_2}{\lambda}$
31a	52	7	49	7	1.11
b	54	8	49	9	0.98
c	50	9	46	10	1.04
36a	57	10	52	11	1.08
b	67	11	48	12	1.11
c	59	12	54	13	1.04
37a	53	13	49	15	1.14
b	60	15	48	16	1.08
c.	58	16	54	29a	1.03
d	49	23	49	29b	1.01
38a	62	26	53	29c	1.01
b	49	27.5	50	30a	0.95
c	48	28	50	30b	0.95
d	48				
39	44				
40a	47	Avg.	50	Avg.	1.04
b	46	Min.	46	Min.	0.95
c	47	Max.	54	Max.	1.11
d	57				
41a	53				
b	56				
c	48				
d	51				
e	48				
f	56				
g	56				
h	50				
42a	47				
b	50				
c	51				
d	66				
e	57				
f	58				
g	58				
h	44				
43b	65				
c	55				
d	52				
e	50				
Avg.	53.3				
Min.	44				
Max.	67				

200 MAT

THE BOSTONIAN SOCIETY

WE ARE EXCITED AND OPTIMISTIC

$\frac{E}{K}$	and	(1) λ_{in}	and	(2) λ_{out}	and
21.5				21	
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186.1				342	
186.1					

TABLE VII
SAMPLE DATA SHEET (RUN 29a)

Barometer 1,30 feet, $\alpha = 0^\circ$

Foil Location: vertical 34.25 cm., horizontal 16.70 cm.

PROFILE DATA

VERTICAL	HORIZONTAL	VERTICAL	HORIZONTAL
36.75	11.00	35.88	31.00
36.76	13.00	35.97	32.00
36.79	14.00	36.56	33.00
36.92	15.00	37.41	34.00
36.95	16.00	37.75	35.00
37.42	17.00	37.19	36.50
37.47	17.40	36.24	38.00
37.61	18.20	35.86	39.50
37.01	19.00	36.08	41.00
36.57	20.00	36.87	42.50
36.25	21.00	37.36	44.00
36.10	22.00		
36.31	23.00		
36.69	24.00		
37.25	25.00		
37.75	26.00		
37.55	27.00		
37.09	28.00		
36.50	29.00		
36.15	30.00		

The above is data for one of the runs in which a complete profile was mapped. Vertical distances are recorded in centimeters and horizontal distances are recorded in inches. Bottom elevation was 15.75 cm.

July 20, 1996 16:2 minutes
1996-07-20 16:20:00 1996-07-20 16:20:00

• Boppow lebensstil was I.T.O. ८० का

TABLE VIII
SAMPLE DATA SHEET (RUN 41b)

Manometer 1.77 feet, $\alpha = 2^\circ$.

Foil location: vertical 23.09 cm., horizontal 16.40 cm.

<u>VERTICAL (cm.)</u>	<u>HORIZONTAL (in.)</u>	
35.22	11.00	Max. (Vert. 33.92 cm,
35.22	13.00	(Hori. 40.40 in.
35.22	15.00	
35.01	17.00	Min. (Vert. 35.82 cm,
34.64	19.00	(Hori. 48.80 in.
34.28	21.00	
34.11	23.00	
34.44	25.00	
34.95	27.00	
35.58	29.00	
35.95	31.00	
35.80	33.00	
35.45	35.00	

The above table is data for one of the runs of the series in which the transient was to be studied and the amplitude was to be noted.

TABLE IX
SAMPLE DATA SHEET (RUN 4/1a)

Manometer 1.015 feet, $\alpha = 3^\circ$, $d_0 = 40.25$ cm.
Foil location: vertical 32.68 cm.

Max.	40.75	cm.
Min.	39.60	cm.
Max.	40.64	cm.
Min.	39.69	cm.
Max.	40.84	cm.
Min.	39.59	cm.

The above is data from a run of a series in which amplitude only was studied.

AT 82W

(add on) THERM AND STRAIN

the model is $\frac{C_1}{C_2} = \infty$ and thus depends
on the boundary condition like

100	27.00	0.00
100	27.00	0.00
100	27.00	0.00
100	27.00	0.00
100	27.00	0.00
100	27.00	0.00

thus we can see that the value is 27.00 at zero load, at loads not

zero we have seen

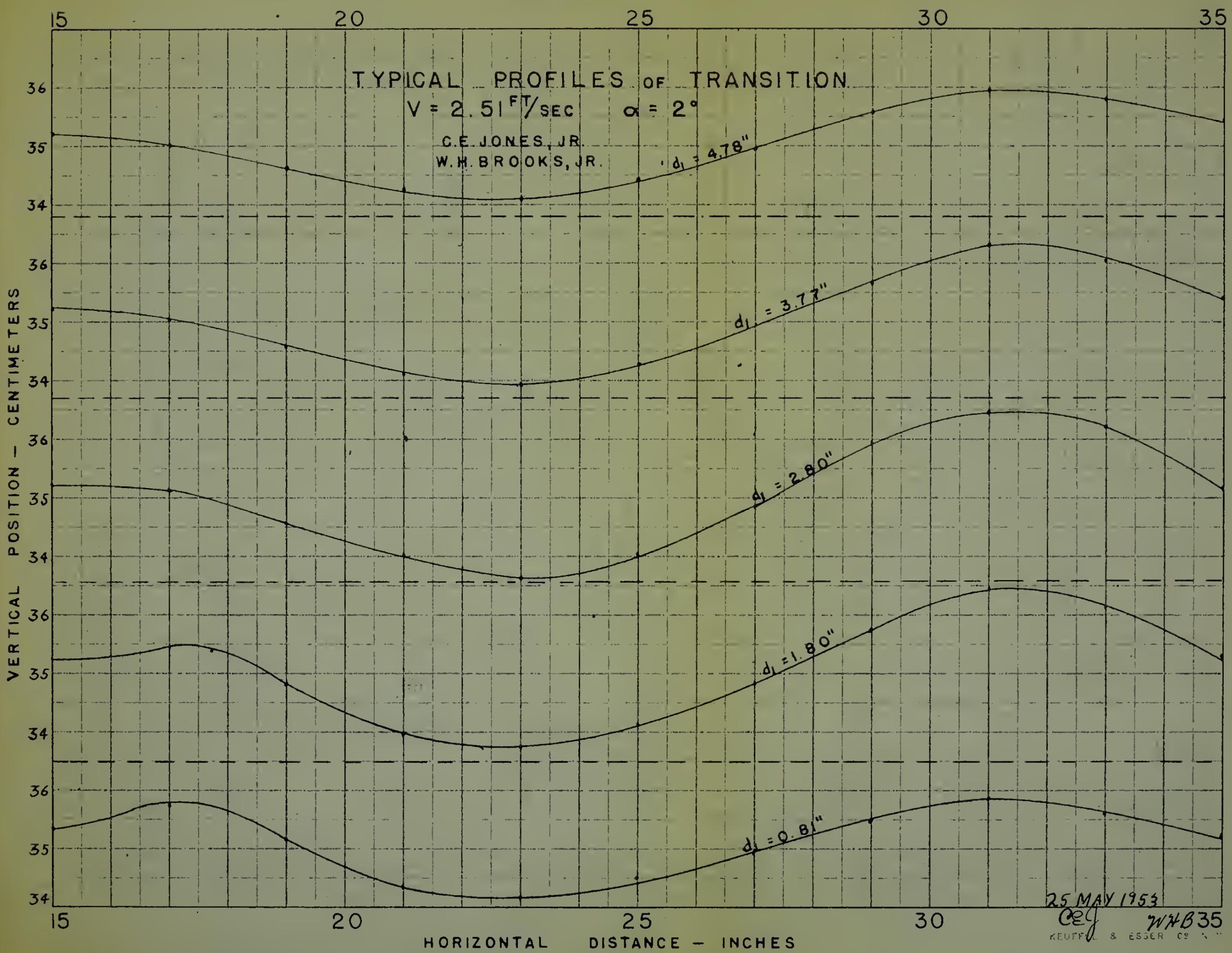


APPENDIX C
SAMPLE INTERMEDIATE PLOTS

ДЪРВАТА

БРАГИ СЪЛНЧЕВИ АЛМАС

FIGURE XV



25 MAY 1953
C.E.J. W.H.B.35
KEUFFEL & ESSER CO. INC.

DIXONIA

GRAN ESTACIONAL SANTA

FIGURE XVI

PLOT OF WAVE PROFILES

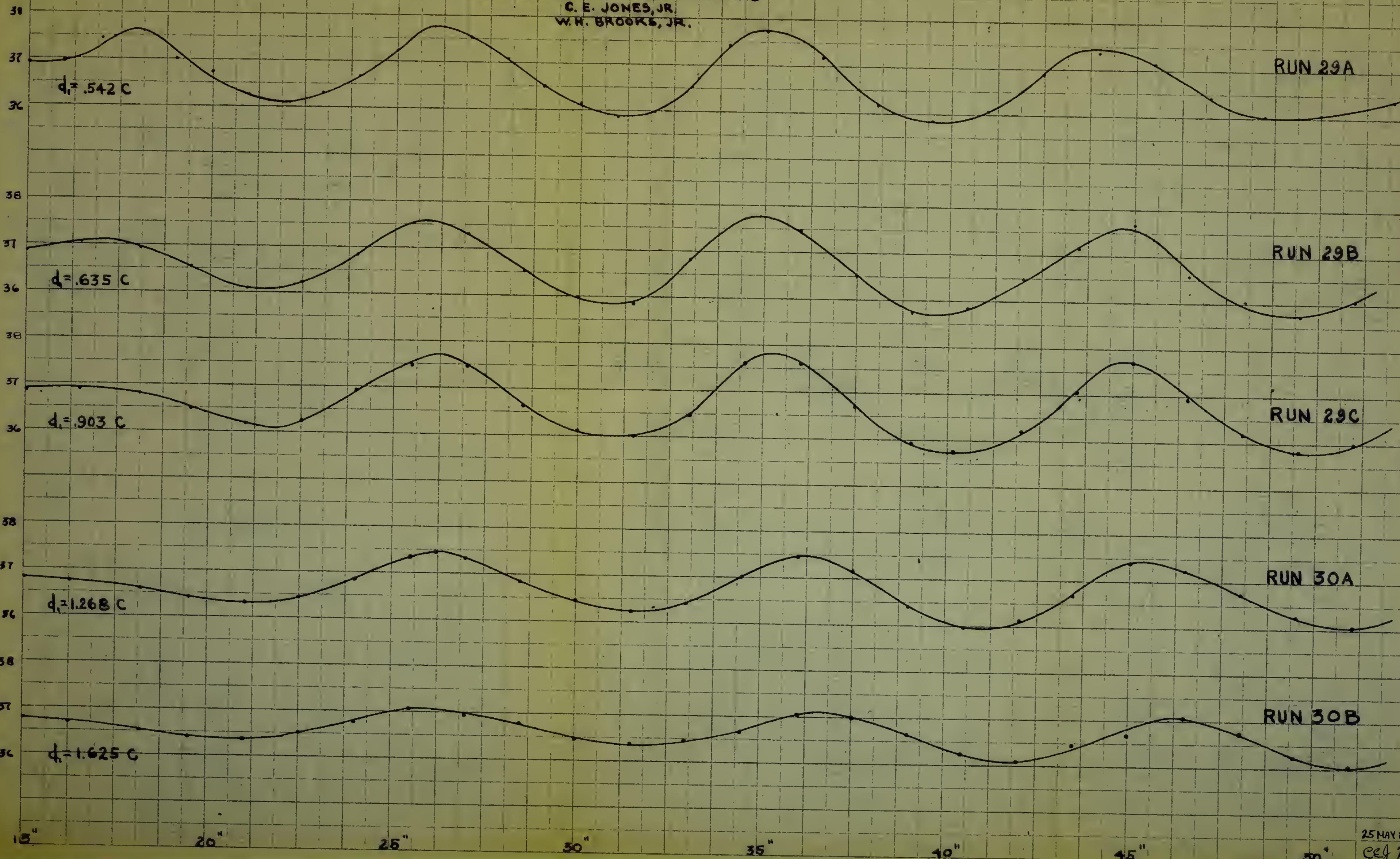
 $\alpha = 0^\circ$ V = 1.98 FT/SEC.

HORI. DISTANCE IN INCHES

VERT. DISTANCE IN CENTIMETERS

C. E. JONES, JR.

W.H. BROOKS, JR.



25 MAY 1953

CEJ WNB



APPENDIX D
LITERATURE CITATIONS

LIBRARY D
EXHIBITS AND SERVICES

LITERATURE CITATIONS

1. Daily, J. W., "Cavitation Characteristics and Infinite Aspect Ratio Characteristics of a Hydrofoil Section". ASME May 1948.
2. Ausman, J. S. "Experimental Investigation of the Influence of Submergence depth Upon the Wave-Making Resistance of a Hydrofoil." Thesis conducted at University of California 1950.
3. Scarborough, J. B., "Numerical Mathematical Analysis", Johns Hopkins Press. Pages 443-445.
4. Lamb, H., "Hydrodynamics" (Sixth Edition), Dover Publications. Pages 402, 404-415.
5. "On Waves" British Association Report 1844. Page 459.

SCOTTISH HUMOUR

poem, which has been written in imitation of it, and
which was sent to "Punch" by a Scotch author, and
is entitled "The Scotch Peacock's Tail" is as follows:
—It is the opinion of all good judges that
"Old Scotland" is inferior to no other country in
the "Puff-Puff, Tattie-Tattie, Tap-Tap" of its
countrymen, and that "Scotch Peacock" is
as good as any. Now I am told that



JUL 2
JL 2260
17 NOV 72

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Thesis
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Jones

An analysis of surface
waves generated by a sub-
merged hydrofoil.

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An analysis of surface waves gen-
erated by a submerged hydrofoil.

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U. S. Naval Postgraduate School
Monterey, California



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An analysis of surface waves generated b



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